



**DEVELOPING A SCHEDULING AND NOTIFICATION SYSTEM TO MAKE A
BALANCED WORK LIFE FOR DOCTOR**

A dissertation submitted to the

School of Computing, Creative Technologies and Engineering

LEEDS BECKETT UNIVERSITY

in partial fulfilment of the requirements for the award of the degree of

Master of Science in Software Engineering

by

MD ROMAN BHUIYAN

77181759

submitted on

10 September 2017

Guided

by

Naga Sowjanya Appari

**School of Engineering & Computing Sciences
(SOCS)**

FTMS COLLEGE

CYBERJAYA

MALAYSIA.

SEPT 2015



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This is to certify that this dissertation work entitled

DEVELOPING A SCHEDULING AND NOTIFICATION SYSTEM TO MAKE A

BALANCED WORK LIFE FOR DOCTOR

is a bonafide record of the work done by

MD ROMAN BHUIYAN

77181759

at FTMS College, Malaysia during the year 2014-2015 in partial fulfilment of the
requirements for the award of the degree of

MSc Software Engineering

Naga Sowjanya Appari

Programme Leader

Submitted for the LEEDS BECKETT UNIVERSITY and the Presentation and Viva
held at FTMS College, Kuala Lumpur, Malaysia on _____.



(Certificate from the Internal Guide)

Naga Sowjanya Appari

FTMS College

Kuala Lumpur, Malaysia.

CERTIFICATE

This is to certify that this dissertation entitled "**DEVELOPING A SCHEDULING AND NOTIFICATION SYSTEM TO MAKE A BALANCED WORK LIFE FOR DOCTOR**" submitted in partial fulfilment of the requirements for the award of the degree of **MSc Software Engineering** to the **LEEDS BECKETT UNIVERSITY, UK** through **FTMS College, Kuala Lumpur, Malaysia** is a bonafide record of the work done by **Md Roman Bhuiyan 77181759** under my supervision and guidance.

Date:

Signature of the Guide

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ABSTRACT

The demand from doctors all over the world has risen in the last decade depriving them of their personal and social engagements. In real terms, most hospitals still prefer the traditional paper based way of doing things including scheduling doctor's shift. Patients find it difficult to see doctors even on appointments dates as the tight schedule leaves no room for doctor to make it to their patients for consultation. This project is aimed at developing a doctor's scheduling system that can be used to schedule doctor's shift and also allow patients to book appointments with doctors

Keywords: Schedule, Appointment, System, Book Appointment

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LIST OF ABBREVIATIONS

| | |
|-------------|--|
| AAMC | American Association of Medical Colleges |
| DSDM | Dynamic System Development Model |
| FDD | Feature Driven Development |
| RAD | Rapid Application Development |
| JAD | Joint Application Development |
| RUP | Rational Unified Processing |

1.0 INTRODUCTION

1.1 MOTIVATION

The motivation for the project came from the fact that, I have been equipped with the skills which could be used to develop IT solutions for almost every industry. The Health industry seems to me the most important as it deals with health related issues on a daily basis and therefore the motivation to help develop the daily processes and routines of the health industry professionals was given birth to.

The fact that I was going to develop an Information system that would be implemented in the health industry to make the industry more efficient and boost performance become a driving force and motivation for me to further research into how it will be achieved.

1.2 BRIEF HISTORY

In recent times, there has been a rise in personal doctor consultation with patients. Reality is that no one wants to fall sick. People do have personal awareness so that they don't fall sick. But this awareness sometimes is not sufficient enough to prevent diseases in human body.

One can imagine the number of people that get sick every day that actually needs doctor's check-up. While doing this doctors end-up working more than their regular shifts, sometimes they work continuously without any break. They hardly manage any time for their social activity like attending family parties, spend some family time with close ones. Surveys shows that doctors are been overworked as described by Campbell (2014) saying *"Care of hospital patients is under threat because overworked frontline doctors are looking after so many sick people that they are missing vital signs of illness that could affect chances of survival"*

Some doctors do shifts up to about 18 hrs a day thereby denying family, social and personal time and engagements. They are often late coming back from the work in normal days and special days like anniversary and birthday celebration of children's or other close relatives they tend to miss out because of his work ethic where patients always come first. The effect of this is that doctors themselves have become endangered to themselves as described by Ewing (2016) saying *"Almost 300 doctors*

working at public hospitals across the country have reported falling asleep at the wheel on their drive home from work”

Talking of work ethic doctors take a Hippocratic Oath while practicing their profession in the beginning and the oath is “do no harm”. To maintain this oath they treat their patients without considering what need to be done to maintain a proper work-life balance. This kind of lifestyle has an effect as professionals don’t want this kind of lifestyle therefore resulting in loss of interest.

The most significant effect is that doctors are making a lot of mistakes from been overworked. Further explanation by Ewing (2016) show that *“The statistic comes from a survey conducted by the New Zealand Resident Doctors' Association (NZRDA) of its members, and also revealed more than 1000 doctors reported they'd made a mistake that affected a patient because they were tired”*

A research by AAMC shows there will be shortage of doctors in near future, if students kept on losing interest in doctor profession that day will come sooner. Some appropriate actions need to be taken before this situation arise, Doctors need to have better work-life balance than what they are getting now. Most of time doctors need to spend extra hours because hospitals don’t maintain proper scheduling system, they can’t visualize the work-load of a particular doctor

Developing and implementing Doctor scheduling system will also help the hospital to keep track of how many doctors are needed and also which category of doctor is required for the better treatment of particular patients.

1.3 PROBLEM STATEMENT

Haven identified the shortcomings on the health industry especially with emphasis on doctors, some of which are no proper work time, irregular working times and the loss of interest from the younger generation due to this kind of irregular lifestyle, there is a need to further look closely to identify the problem and further proposed a solution. The problem statement is to ***“develop a Doctor’s Scheduling System that will be used to track number of doctors, their respective work as well as their schedules.”***

1.4 SOLUTION TO THE PROBLEM

The solution to the problem is one that is simple but a bit complicated based on the identified problem. The fact still remains that a scheduling system needs to be develop

to incorporate all doctors' activities and routines to make the interaction between doctors and patients more effective and further improve doctor's performance to their respective patients. The Doctors scheduling system will also incorporate other functionalities that would further enhance doctors.

1.5 BENEFITS OF THE AUGMENTED REALITY

This describes the benefits of the Scheduling System from the doctor's point of view as well as patient's perspective. The benefits includes

- It helps doctors establish a stable work schedule
- It will help doctors attend to their patients more effectively
- It will also help patients track and see doctors schedules
- It will also help patients see and know when doctors are available for consultation.
- It will help the Doctors maintain a steady and healthy work life.

1.6 AIMS AN OBJECTIVES

1.6.1 *Aim*

The aim of every project is always related to the problem statement. It is the main goal of the entire project. The aim of this project is to develop a Doctor's Scheduling System that will be used to track number of doctors, their respective work as well as their schedules

1.6.2 *Objectives*

The objectives are the steps taken in order for the aim of the project to be achieved. The objectives include:

- Research into doctors daily routine and processes with the aim of observing all processes and come up with functionalities
- Research into development and implementation of Management Information Systems with emphasis on doctors scheduling system
- Research into implementation of System methodology and how it affects system development
- Research into configuration and integration of storage capabilities as it affects the proposed system to be developed

- Research into the developmental platforms with the aim of selecting the most appropriate one for the development and implementation of the proposed system
- Finally develop a full functional Doctor's Scheduling System

1.7 PROJECT LIMITATIONS

Every project will definitely have limitations are to hindrances why some of the requirements may not be able to be fulfilled. Some of the limitations that is likely to be faced are

- Time
Time is always the most common limitations as projects requirements may change over time with the time frame not changing
- Technical skills
This might be another limitation as the researcher though is at a level where technical skills to develop the proposed system is possesses, it might still turn out to waste time as this is unpredictable
- Relevant materials
Having access to relevant materials sometimes can be the defining moment in a project breakthrough. Though the researcher's research skills is good, one can never predict the kind of materials one might have access to
- Development approach
This deals with programming language and methodology. The research will make sure this does not posse more problem than is expected

1.8 RESEARCH QUESTIONS

Each research always generate a lot of questions that the research itself will answer over the course of the project execution. The answer that is obtained from these questions will form the basis for the research. Some of the research questions include:

- What are the main functions of doctors in the hospital?
- How can their functions be captures and turned into requirements?
- How does implementation of information systems affect the duty execution of doctors?
- Do hospitals really need system integration like the Doctors Scheduling system?

- How can the system be designed, developed and integrated into a typical functional hospital?
- What infrastructure is needed to facilitate the integration of such as system?
- What will be the overhead cost of development and integration?
- What are the actual benefits of such a system?
- How does such system impact and affect effectiveness and performance of doctors to patients in hospitals?
- What size of storage should be considered?

The answers that these questions generate will help define the pattern of research as it is always important to have a defined pattern of research.

1.9 RATIONALE

Because of my first job I get to work very closely with doctors, I have seen them working long hours, and there are a lot of complaints from his family members because he can't manage time for his family. From doctors' point of view patients always come first and they always give priority to their patients and their goal is to make their patients healthy. I think we should also do something from our own state so that they can have proper work-life balance.

- This application will help doctors to manage their time schedule so that they can spend quality time with their family.
- Managing work load through this application will help doctors to have healthy mind and body, which will make him more focused on his work.
- With balanced work load and interactive social life this application can make a doctor happy.

1.10 BACKGROUND OF THE STUDY

The background of study originates from the fact that the researcher has worked closely with doctors in which the work life and schedule is seen as very irregular and unbalanced. Doctors work for long hours in the hospital once they are on duty. This has also become worse due to the fact that doctors are practically detached from their personal, social and family life.

For doctors, patients will always come first in everything but not to the detriment of doctors as well. Observation was carried out and the result showed that manual

scheduling can no longer be used, not even in the situation where the number of doctors assigned to a typical hospital has doubled while patients have increase to five times he original number.

Over time doctors effectiveness and overall performance has gradually dropped and things do not seem to be improving. This gave rise to the idea of developing a system that helps hospital schedule doctors into shifts, making them available for patients at a stratified time.

The effect and impact on the doctors cannot be overemphasised as it will not only improve effective service but al boost doctor performance. This is seen as important to the patients.

2.0 LITERATURE REVIEW

2.1 INTRODUCTION

The literature review is where the domain research takes place. It covers both research area and domain, the related works that has been carried out in relation to the domain area of research as well as the proposed system in details. The area of domain research also defines the boundaries and scope of the research as it is always good to define ones research so as to have focus from the beginning right till the end without researching into irrelevant domains.

2.2 AREA OF RESEARCH

2.2.1 *Augmented reality*

The augmented reality is a way of superimposing a computer generated image on a user's view of the reality of the research which further provides a composite view of what to expect. In this case, what is considered important is the eventual development of a Doctor's Scheduling System. This means consideration is given to information system as the Doctors Scheduling System can be an information system on its own. This leads well into the consideration management information systems

2.2.1.1 Management Information System

Narine (2006) described Management Information System as *“basically concerned with processing data into information, which is then communicated to the various departments in an organization for appropriate decision-making.”* The illustration is given below

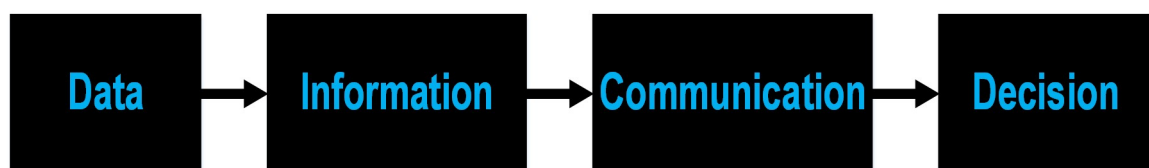


Figure 1 Showing Information Flow in an Information System

Sarkissian (2011) described Management Information System as *“a computer-based system that provides the information necessary to manage an organization effectively”*. Further explanations showed that *“an MIS should be designed to enhance communication among employees, provide an objective system for recording information and support the organization's strategic goals and direction”*.

2.2.1.2 Types of Information System

Operations Information System (OIS)

Sarkissian (2011) described an OIS saying “*An operations information system gathers comprehensive data, organizes it and summarizes it in a form that is useful for managers*”. Further explanation reveals that its components includes:

- Event Derivation Engine
- Operational Data Store
- Legacy OLTP
- Intelligent Networks
- Intelligent Network Adapter (INA)
- Initial State Service (IIS)
- Access Points
- Capture Points

Decision Support System (DSS)

Rouse (2010) described decision support system saying “*A decision support system (DSS) is a computer program application that analyses business data and presents it so that users can make business decisions more easily. It is an "informational application" (to distinguish it from an "operational application" that collects the data in the course of normal business operation).*” She went on to explain saying that information that a decision support application might gather and present can be:

- *Comparative sales figures between one week and the next*
- *Projected revenue figures based on new product sales assumptions*
- *The consequences of different decision alternatives, given past experience in a context that is described*

It is also described as been interactive, a system that is used by top management without external help. It provides information to make informed decisions. Its components are:

1. Database Management System (DBMS)
2. Model-bases Management System (MBMS)
3. Dialog Generation and Management System DGMS)

This provides an interface between the user (manager) and the system itself

Transaction Processing System (TPS)

Sharma (2009) described a TPS saying “*a Transaction Processing System (TPS) is a type of information system that collects, stored, modifies and retrieved the data transaction of an enterprise*”

Sarkissian (2011) also described TPS saying “*Transaction-processing systems are designed to handle a large volume of routine, recurring transactions*”.

Nam (2006) further explained that “*A transaction processing system plays a role as a mediator that accepts transaction requests from users, dispatches these requests to the database system, coordinates the execution of the involved transactions, and forwards transaction results to the original acquirers*”.

Transaction Processing System (TPS) is made up of components based on each task it is allocated to perform. These are:

1. Transaction Manager
2. Scheduling Manager
3. Log Manager

Sharma further described the types of Transaction Processing System into two main types:

1. Batch Processing
2. Real Time Processing

Expert System and Artificial Intelligence (ES and AI)

Rouse (2005) described it as “*An expert system is a computer program that simulates the judgement and behaviour of a human or an organization that has expert knowledge and experience in a particular field*”.

Further explanation made revealed that “*Typically, such a system contains a knowledge base containing accumulated experience and a set of rules for applying the knowledge base to each particular situation that is described to the program*”

They can also be described as systems that use human knowledge that has been stored in a computer to solve problems which would naturally need human expertise to

solve. It uses very flexible thinking processes and can also accommodate new knowledge.

A consideration of the proposed system to be develop is more of operations. This means the doctor's scheduling system will be developed to be an operational information system capturing the activities of doctors as they relate to their respective patients. This is established which leads us into the functionalities which creates of a composite view

2.2.2 *Tracking and Registration*

The tracking describes keeping tracks of the users of the proposed system users to see what they do whenever they access the system. Tracking can also be done in two ways: using time stamp or session. The time stamp enables the system to track each user's access taking not of the time accesses gained and logout is done. Session tracking is done by initiating session whenever a user gains access into the system. This also forms a platform for security in the system

Registration in this regard describe the process that is done to become a valid user of the system. This can be done in so many ways depending on how one wants to develop the system. For the registration process to be effective, the admin will be responsible for adding each doctor added to the team.

2.2.3 *Display Technology*

The display technology is integrated into the system that would be developed. This described the interface that the users can interact with. This will be developed to have an interactive graphical user interface that is interactive and allows the users to be able to use the functionality developed into the system. This is the interface that all the users of the system interact with. The proposed system is best developed and implemented as web based system accessible from remote location.

2.3 RELATED WORKS

Now that it has been that the doctors scheduling system would be developed, there is a need to critically examine similar related works. The doctor scheduling system is only a part of a bigger system and so is examined a part of a full enterprise system. In order to be able to do that, three different works in terms of system would be considered. These are:

- NueMD
- eHospital
- MediTourn

2.3.1 *NueMD*



The NueMD Medical Billing Software is a comprehensive complexity suite of software and services for practically or sizes. It comprises of features such as

- **Appointment Scheduling:** this is the feature that allows doctors and other hospital personnel appointment to be booked
- Practice Management
- **Medical Billing Software:** this feature incorporates and handles all billing hospital billing and transactions
- **Electronic Health Records:** this is a feature that allows health records of patients to be accessed via the internet
- **Medical Billing Services:** services that is used for handling all financial transaction that has to do with the hospital

It is developed to have very robust medical billing capability. Its billing services offers expertise in two main areas:

- expertise of Certified Professional Coders
- transparency of constant communication about claims statuses

NueMD also offers robust functionality for clinical workflow. It also has the following features among other which actually gives it the edge over other available software in its domain:

- **Charting:** this features allows doctors and hospital personnel's to view patients and hospital data and information in a graphical manner that is useful for them to actually perform their respective jobs
- **E-Processing:** this features allows normal processing that takes place in the hospital to be processed electronically
- **Laboratory Report Tracking:** a feature that allows tracking of patients laboratory report and been able to access it when needed
- **Secure Fax Management:** feature that management fax that comes into the hospital and goes out of the hospital

Its interfaces are given below

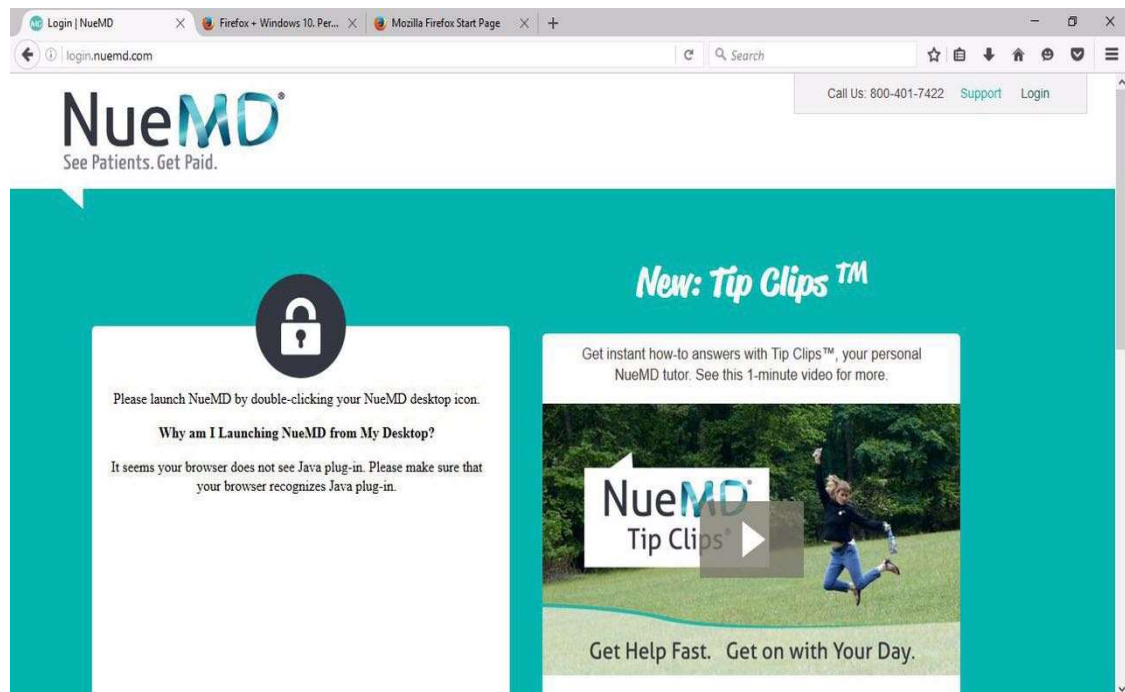


Figure 2 Showing Home Page of NueMD

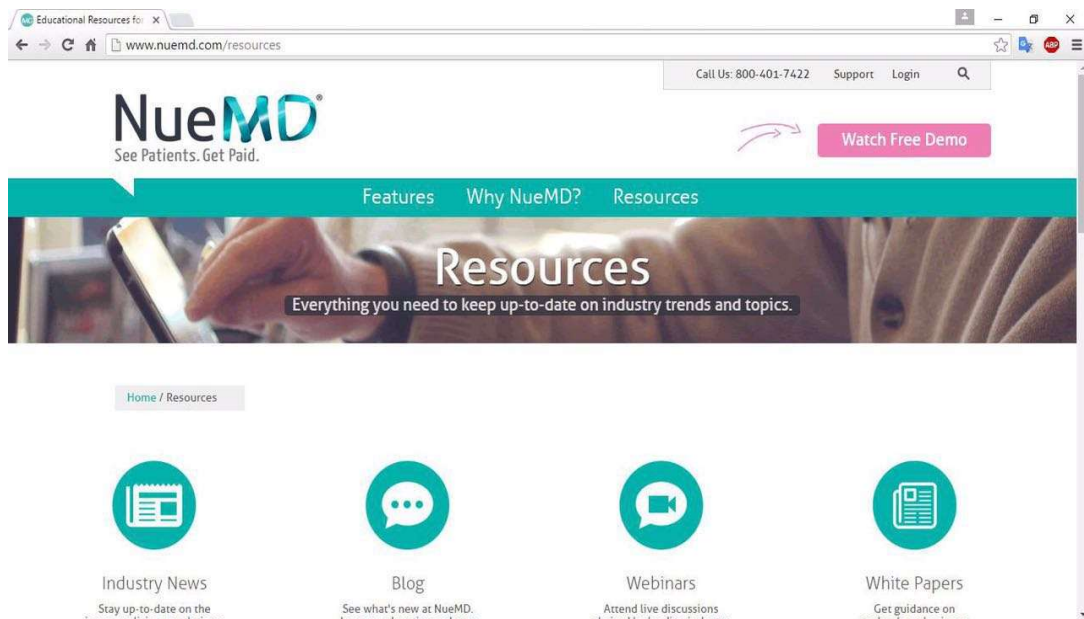


Figure 3 Showing Resource Page of NueMD

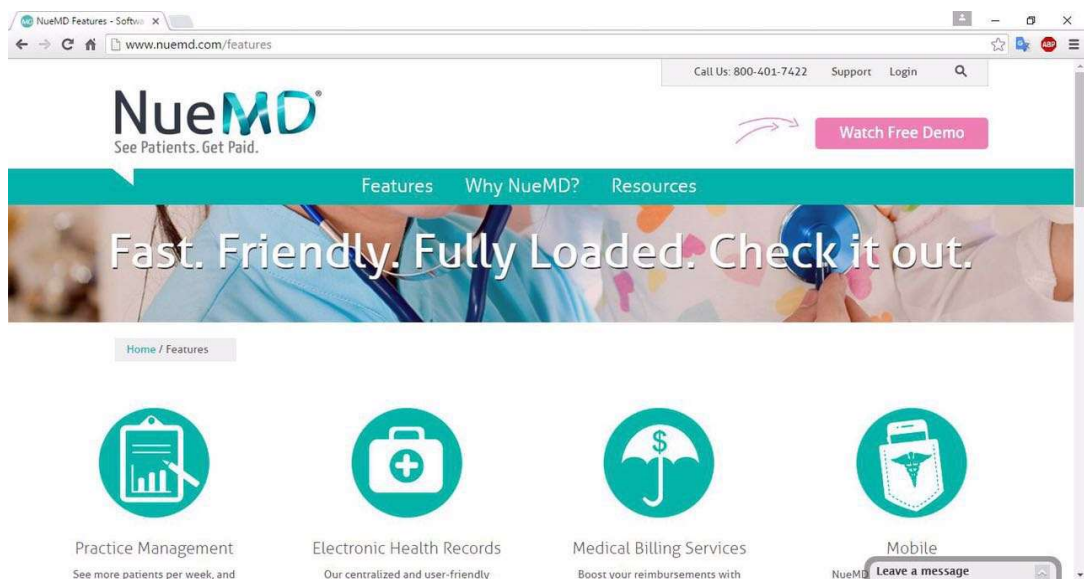
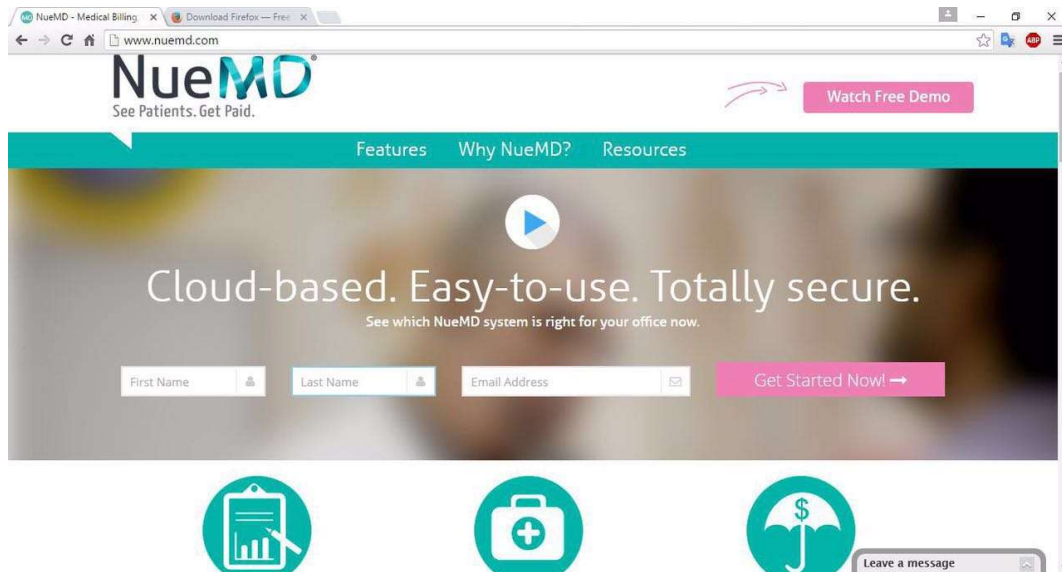


Figure 4 Showing the Features of NueMD



2.3.2 *eHospital*



eHospital System is a very comprehensive and well integrated medical information system that has been designed to manage all aspects of hospital operation and processes such as the medical, administrative, financial as well as legal process. It is deployable over the cloud as well as installed on work stations. Its training are very detailed including documentations, webinars, live and in Person trainings. It has 24/7 support. Its functions includes

- **Appointment:**
Allows patients to schedule appointments with hospital or health care personnel's
- **Outpatient management:**

This feature is responsible for managing patients that have been referred to other hospitals or medical centres

- **Health check-up:**

Feature that gives information about patients check up

- **Laboratory:**

This is responsible for electronically storing lab results of patients and making it available when needed

- **Inpatient Management:**

This features is responsible for managing patients admitted into the hospital

- **Billing:**

A feature that handles all hospital financial transactions

- **Nurse station:**

This is a feature that indicates where each nurse in the hospital is positions

- **Reports:**

Feature that provides hospital data and information in a more organised way for personnel to be able to use it

- **Pharmacy:**

This is a part of the system that gives details of medications that are available and non-available

Its interface are very user friendly and attractive for users to use and enjoy. Some of the interface design is given below.

Login



Figure 5 Showing Login page of eHospital

Main Menu



Figure 6 Showing Main Menu of eHospital

Appointment

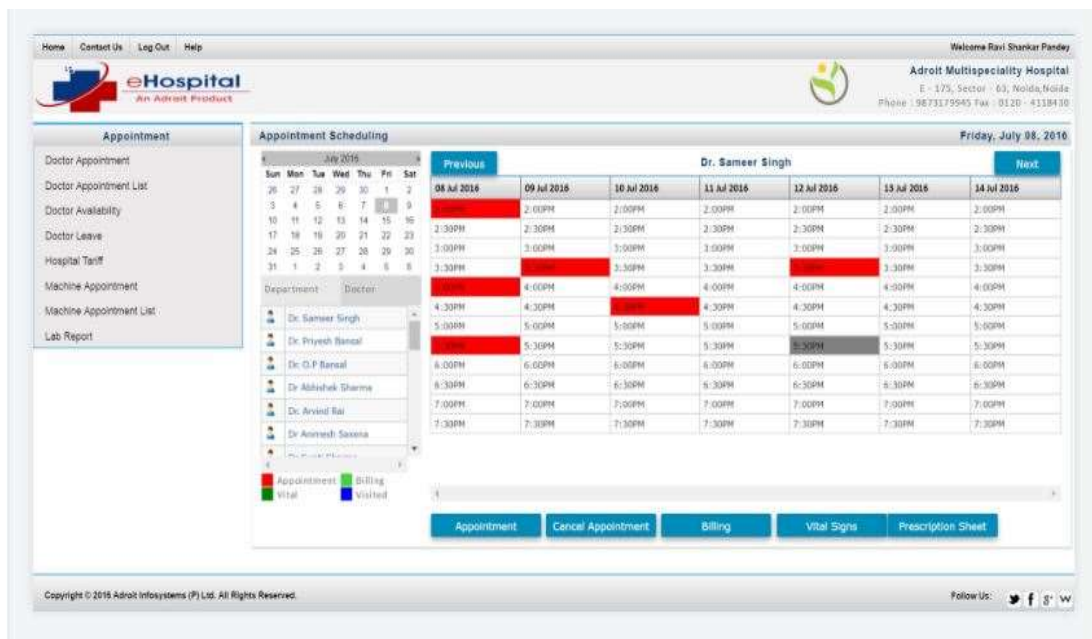


Figure 7 Showing Appointment page of eHospital

Outpatient Management

Home Contact Us Log Out Help

Welcome Ravi Shankar Pandey

Adroit Multispeciality Hospital
F - 175, Sector - 63, Noida, Noida
Phone : 9873179545 Fax : 0120 - 4118430

Outpatient Management

Patient Registration
Patient Search
OPD Billing
Refund
Credit Bill Settlement
Hospital Staff
Daily Collection Report
User-Wise Collection Report

OPD Billing

Last Visit Bill Number Receipt Number Lab Number

Bill Number 2016/R- Bill Number Receipt Number 2016/R-
UNIT CMI 22 Paper Cash
Patient Name: Brav Age/Sex: 22 Male
Referral: Internal Doctor

Services [+ Outpat Order](#) [+ Services](#)

| SN | Service Name | Amount | Discount | Doctor | Charges | Discount | Payer Amount | Patient Amount |
|----|---------------------------|--------|----------|--------|---------|----------|--------------|----------------|
| 1 | CHEST X - RAY AP | 400 | 0 | | 0 | 0 | 0 | 400 |
| 2 | CT HEAD-PLAIN | 2200 | 0 | Select | 0 | 0 | 0 | 2200 |
| 3 | CT SCAN JOINTS (SHOULDER) | 500 | 0 | | 0 | 0 | 0 | 500 |

Payment Details Discount Auth Current Bill Save Refresh Bill Print

Remarks: Remarks:

Total Amount 3100
Received Amount 0
Balance Amount 3100

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Figure 8 Showing Outpatient Management of eHospital

Patient's Records

Home Contact Us Log Out Help

Welcome Ravi Shankar Pandey

Adroit Multispeciality Hospital
F - 175, Sector - 63, Noida, Noida
Phone : 9873179545 Fax : 0120 - 4118430

FIRST FLOOR [Change Floor](#)

Admitted Patient List
GENERAL WARD-1 No Patient found
GENERAL WARD-2 No Patient found
SUITE ROOM No Patient found
PRIVATE ROOM No Patient found
DELUXE ROOM

Admission No - 6, Patient Name - RADHESHYAM

Major Complaints Home Visit Medical History Sign and Symptoms Physical Examination Diagnosis Management Plan
Service Charge Slip Doctor Visit Home Note Discharge Summary Home Activity report

Vital Signs Details

B.P. (mmHg) * B.P. (mmHg) Weight (kg) 65
Pulse (bpm) * Pulse (bpm) Height (cm) 170
Temp (°C) * Temp (Trough/On/Sup-F) BMI (kg/m²) BMI (kg/m²)
Remarks: Remarks: Time* Select
Date* 08/07/2016 Save Clear

Underweight = BMI Less than 18.5 | Normal weight = BMI of 18.5 to 24.9 | Overweight = BMI of 25 to 29.9 | Obesity = BMI of 30 or greater

| Select | S.P.(mmHg) | Weight (kg) | Pulse (bpm) | Height (cm) | Temp (°C) | BMI (kg/m ²) | Vital Date | Time |
|----------------------|------------|-------------|-------------|-------------|-----------|--------------------------|------------|----------|
| Edit | 120 | 65 | 124 | 170 | 44 | 22.77 | 18/06/2016 | 1:30 AM |
| Edit | 44 | 44 | 44 | 44 | 44 | 22.77 | 18/06/2016 | 5:15 AM |
| Edit | 143 | 433 | 34 | 433 | 43 | 2389 | 12/06/2016 | 12:00 AM |
| Edit | 1554 | 58 | 58 | 45 | 45 | 22.77 | 12/06/2016 | 12:00 AM |
| Edit | 15 | 5 | 45 | 3 | 435 | 33333 | 12/06/2016 | 12:10 AM |
| Edit | 120 | 65 | 100 | 170 | 100 | 2348 | 24/06/2016 | 12:10 AM |

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Figure 9 Showing Patients Record of eHospital

2.3.3 *MediTouch*



MediTouch is a Health care management system that is a complete Electronic Health Record (EHR) basically designed to be used as web based system and also offer hands-on touchscreen user interface. It is easy to use and a highly differentiated system.

The core HER offers functionality such as

- **Charts:**
Chart that shows information in different forms to doctors and medical staff that interpret it to treat their respective patients
- **Problem List:**
This is a features that outlines patient's problem, the patient's referral doctor and other minor information that is useful
- **Medication Management:**
This is a feature that medical staff use to manage medication in the hospital.
- **Electronic Prescribing:**
This is significant to doctors as doctors can electronically prescribe medication for patients and can eb accessed by authorised staffs
- **Allergy checks:**
This is a feature that allows hospital personal check for patient's allergy and electronically document it
- **Order management:**
Order management also help hospital management to manage hospital equipment, medications and other hospital essentials that are used on a daily basis
- **Lab tests:**
A feature that allows lab test to be documented electronically and can be accessed by authorised hospital personal

- **Document management:**

This is the feature that manages hospitals documents electronically

The system can also be configured to meet a provider's personal charting preferences and custom forms can be implemented to work with MediTouch's touchscreen technology. One of the strength and advantages of MediTouch is that it can be deployed as a standalone or in partnership Health Fusion's practice management system. The pricing for MediTouch is on a pay-per-use and the monthly subscription fees includes all customers support including training services as well

The interface is user friendly and some of it are given below

Login

Log-in - HealthFusion Me X

HEALTHFUSION INC. [US] https://login.healthfusion.com

SINCE 1998 Trusted by doctors (877) 523-2120 Login Support Contact Request a Demo

HealthFusion® MediTouch®

EHR Billing Partner Program Resources Blog Testimonials Company

Practice Management / EHR

User Id

Password

Log In Reset

By Logging In, I Agree to the HealthFusion User Agreement

Good things come to those who share. Receive up to \$500 for every colleague you refer to MediTouch. Learn How

99% ICD-10 success, 99% first pass rates. Learn How

Never a Lost Claim Track down your AR claims workload. Learn How

Mobile Rx, free for all MediTouch users. Learn How

Need help or have questions? Attend a daily webinar to learn more.

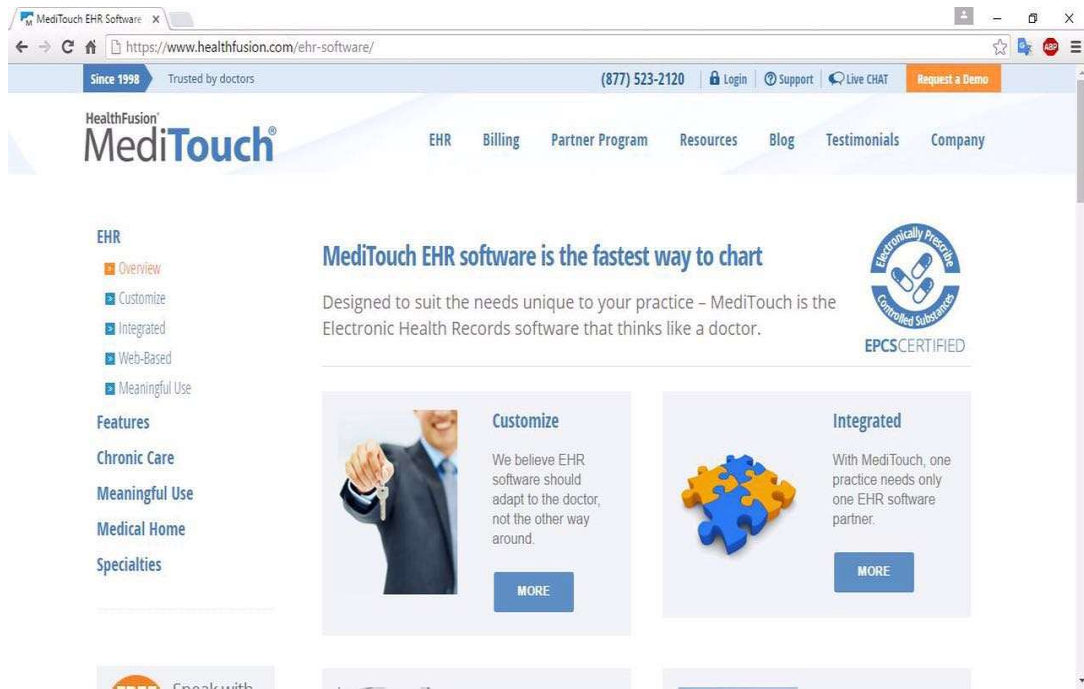
HealthFusion, Inc.
4075 Sorrento Valley Blvd
San Diego, CA 92121
Phone: (877) 523-2120

HealthFusion's MediTouch EHR 4.0 2014 Edition was certified on June 13th 2013.
For 2014, 2015, and 2016 EHR incentive registration & attestation, use EHR Cert. ID A014E01K1GRMEAN
More about our certification »

Drummond
>>> certified
COMMONWEALTH ASSOCIATES

Figure 10 Showing Login page of MediTouch

Demo page



About Page



Figure 11 Showing About us Page of MediTouch

Contact page

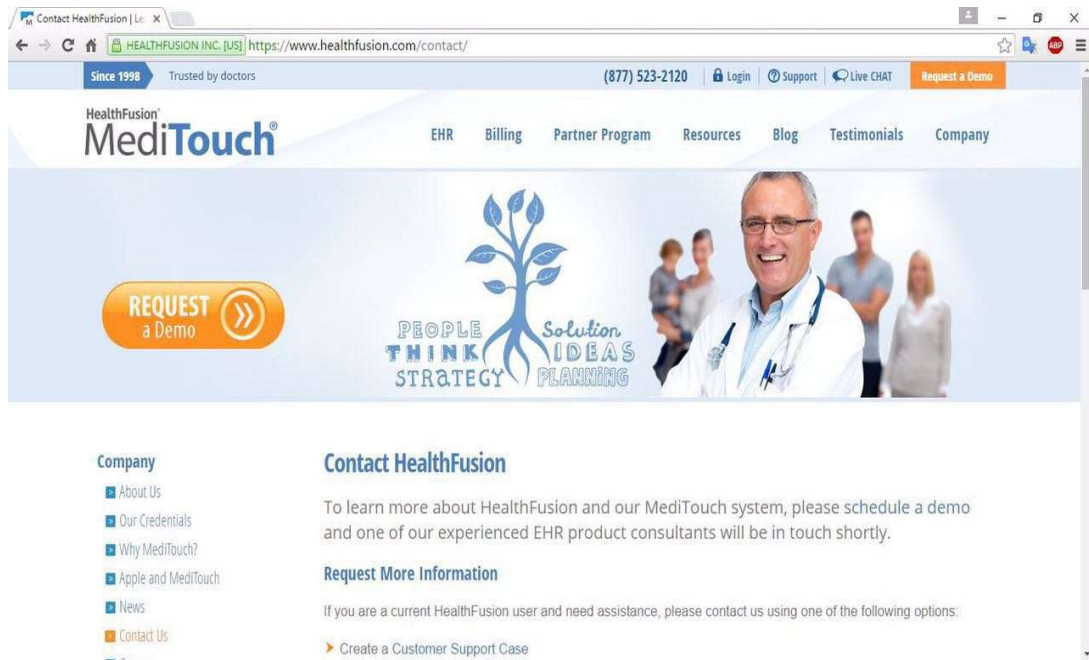


Figure 12 Showing Contact Page of MediTouch

2.4 PROPOSED SYSTEM

2.4.1 Introduction

The proposed system is one that is designed to make the work of doctors more flexible in terms of time management and workload. It is also designed to manage other employees among other things as emphasis is placed on doctors. The features and functionalities have been integrated in order to make sure the doctor's workload does not exceed a limit. This is also in line with the fact identified earlier that doctors should time for other commitments. The features and functionalities are described in details

2.4.2 Features and Functionalities

Some of the features of the system includes

- **Basic System Setup**

The basic system setup contains functions such as country, currency, time zones, hospitals and license settings.

- **Hospital Settings**

This is the function that manages hospital information as well as employee management among other things.

- **User Management**

This is where user information are all managed. User management include user account view, password reset and change among other things

- **Access Management**

This gives a detailed information of who is logged onto the system and their respective roles as assigned to them. It also manages how roles for each user is set up

- **Super Admin**

This is the admin itself where highly technical activities can only be done such as system configuration, theme configuration as well as email configuration for general use

- **System Setup**

This is where the system can be configured to match and meet user needs

- **Monitor and Support**

This is more like where system maintenance is done. It takes into consideration features such as Audits and system logs, ticket support, user feedback as well as monitor system queue

2.5 CONCLUION

The literature review has been done in details by first discussing the area of research, related works as well as proposed system. The research area discussed in details the segmented reality which led to the examination and review of information systems as well as types. Tracking and registration among other features were discussed with display technology. Related works were also considered and review. This entailed reviewing similar systems such as NueMD, eHospital as well as MediTournch. The proposed system discussed in details the system features and functionalities

3.0 METHODOLOGY

3.1 INTRODUCTION

An overview of the proposed system has been given. For the proposed system to be fully developed to meet its desired requirements, there has to be data gathering exercise aimed at getting relevant information towards developing the system. At the same time, a systematic step by step approach has to be used in the design and development of the proposed system. Research methodology and system methodology comes handy at this critical point of the research.

3.2 RESEARCH METHODOLOGY

Research methodology is responsible for data gathering techniques that can be used in gathering information that would be further be used in the development of the proposed. This is very important at this time as it also integrates user in a way to give opinion on how the system might turn out to be and the expectations from using it. The type of data to be gathered is totally dependent on the kind of system to be developed.

Research methodology techniques vary from the use of questionnaire to interview sessions, survey, observation and focused groups. It is left for the researcher to use the most suitable. Based on the proposed system requirements, the researcher has decided to use both interview and questionnaire as data gathering tools. This is due to the fact that interview helps get very detailed information while the questionnaire helps to actually understand users from their point of view.

3.2.1 Interview

An interview is usually done by selecting list of open ended questions and asking a professional in that domain targeted questions aimed at getting detailed information that would further help in the design and development of the proposed system. An interview has been designed with 10 structured questions. This are given below:

1. Can you describe the Doctor's Scheduling System based on features?
2. Can you outline how best to generate requirements for a proposed system?
3. Can you suggest a suitable methodology for the proposed system?
4. Can you suggest a suitable developmental platform for the proposed system?

5. Can you suggest a suitable database for the storage of information for the proposed system?
6. Can you suggest a suitable framework for the proposed system?
7. Can you identify possible threats that may be encountered in the process of developing the proposed system and how to resolve them?
8. Can you outline the suitable test plans for the proposed system?
9. Can you suggest best security measures for the proposed system?
10. In conclusion, what do you think the outcome of the proposed system would be like?

3.2.2 Questionnaire

Questionnaires are closed ended questions targeted at getting the opinion of prospective users. It also helps the researcher to take a lot of things into consideration when designing and developing the proposed system. A list of structured questions have been package in order to get prospective user's opinion of their respective expectation of the system

(All information provided would not be made public and would only be used solely for the purpose for which it is meant to)

1. Have you ever used an online system before?

| | |
|----------|--------------------------|
| A. Yes | <input type="checkbox"/> |
| B. No | <input type="checkbox"/> |
| C. Once | <input type="checkbox"/> |
| D. Often | <input type="checkbox"/> |
| E. Never | <input type="checkbox"/> |

2. Have you ever used a system similar to Doctor's Scheduling System?

| | |
|----------|--------------------------|
| A. Yes | <input type="checkbox"/> |
| B. No | <input type="checkbox"/> |
| C. Once | <input type="checkbox"/> |
| D. Often | <input type="checkbox"/> |
| E. Never | <input type="checkbox"/> |

3. Do you think there is a need for this kind of system?

- A. Totally Agree []
 - B. Agree []
 - C. Normal []
 - D. Disagree []
 - E. Totally Disagree []
4. In terms of cost do you think it's strategic for any hospital to fund the development and implementation of the Doctor's Scheduling System?
- A. Totally Agree []
 - B. Agree []
 - C. Normal []
 - D. Disagree []
 - E. Totally Disagree []
5. In terms of hospital management, do you think implementing a system such as Doctor's Scheduling System is wise?
- A. Totally Agree []
 - B. Agree []
 - C. Normal []
 - D. Disagree []
 - E. Totally Disagree []
6. Do you think implementing a system such as Doctor's Scheduling System will make doctors job a lot easier?
- A. Totally Agree []
 - B. Agree []
 - C. Normal []
 - D. Disagree []
 - E. Totally Disagree []
7. Do you think implementing a system such as Doctor's Scheduling System will make doctors job a lot harder?
- A. Totally Agree []
 - B. Agree []

- C. Normal []
- D. Disagree []
- E. Totally Disagree []

8. Do you think implementing a system such as Doctor's Scheduling System will have a positive effect on other processes in the hospital?

- A. Totally Agree []
- B. Agree []
- C. Normal []
- D. Disagree []
- E. Totally Disagree []

9. Do you think implementing a system such as Doctor's Scheduling System will have a negative effect on other processes in the hospital?

- A. Totally Agree []
- B. Agree []
- C. Normal []
- D. Disagree []
- E. Totally Disagree []

10. Do you think implementing a system such as Doctor's Scheduling System makes it easier to manage hospital general information?

- A. Totally Agree []
- B. Agree []
- C. Normal []
- D. Disagree []
- E. Totally Disagree []

11. Do you think implementing a system such as Doctor's Scheduling System makes it harder to manage hospital general information?

- A. Totally Agree []
- B. Agree []
- C. Normal []
- D. Disagree []

- E. Totally Disagree []
12. Do you think the system is safe enough to be implemented considering the kind of information it would store and handle on a daily basis?
- A. Totally Agree []
- B. Agree []
- C. Normal []
- D. Disagree []
- E. Totally Disagree []
13. Do you think implementing a system such as Doctor's Scheduling System will increase doctor's performance?
- A. Totally Agree []
- B. Agree []
- C. Normal []
- D. Disagree []
- E. Totally Disagree []
14. Do you think implementing a system such as Doctor's Scheduling System will bring more motivation for doctors and other hospital employees?
- A. Totally Agree []
- B. Agree []
- C. Normal []
- D. Disagree []
- E. Totally Disagree []
15. What is your expectation about the Doctor's Scheduling System?
- A. It should be a very basic system
- B. It should be a simple but comprehensive system
- C. It should be a system with features that covers all doctors processes
- D. It would like any other system with basic features and room for enhancements
- E. It should be a highly sophisticated system that is worth investing in

3.3 SYSTEM METHODOLOGY

3.3.1 Introduction

System under requirements specification as well as logical designs before the physical development is done. In the logical design, it is essential. A system methodology is best described in terms of development and framework as well as structure and control plan. AMTF (2014) described it saying “*software development methodology or system development methodology in software engineering is a framework that is used to structure, plan, and control the process of developing an information system*”.

Further explanation also revealed that there are a couple of system methodologies that can be used and the developer needs to examine each one to see which best fits the proposed system to be developed. A few of the system methodologies would be examined to see which one would best fit the proposed system which is the Doctor’s Scheduling System

3.3.2 System Methodologies

3.3.2.1 Dynamic System Development Model (DSDM)

It was developed in the UK as an evolution of rapid application development practice. It is known for providing training support as well as documentation techniques. It is based on 9 principles which are

1. *Active user involvement.*
2. *Empowered teams that the authority to can make decisions.*
3. *A focus on frequent delivery of products.*
4. *Using fitness for business purpose as the essential criterion for acceptance of deliverables.*
5. *Iterative and incremental development to ensure convergence on an accurate business solution.*
6. *Reversible changes during development.*
7. *Requirements that is base lined at a high level.*
8. *Integrated testing throughout the life cycle.*
9. *Collaboration and cooperation between all stakeholders.*

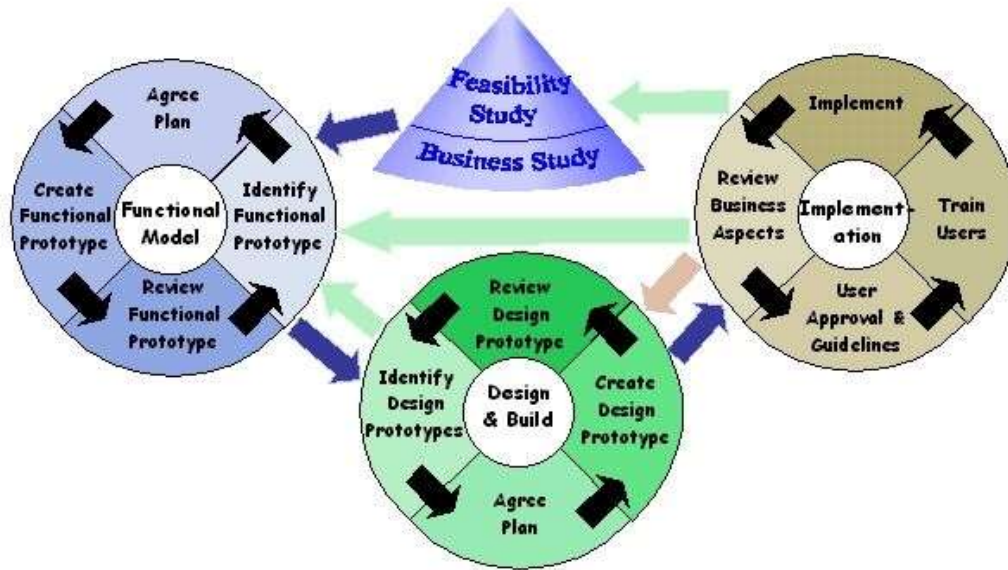


Figure 13 Showing DSDM Methodology

The DSDM is made up of 5 developmental stages as described by Clifton and Dunlap (2003) which are:

- **Pre-Project**

The project conceptualisation and decision to start the project is made as it also is made up of

- **Feasibility Study:** finding out if the project is viable or not
- **Business Study:** finding out the prospects in terms of business side of the project.

- **Functional Model**

Functional prototype of a system are first made before the modelling takes place, this is where the functional is made as described by Clifton and Dunlap (2003) saying “*prototype of the functions the system should perform and how it should perform them.*” It stages are:

- Investigation
- Refining
- Consolidation

- **Design and Build**

This is the stage where the logical design and the physical development of the system is done. The logical design involves system modelling while the physical development involves coding and debugging

- **Implement, Deploy and Maintain**

Project is finalised, handed over, documentation of the product is done and a review document is also produced that compare the requirements of the system with fulfilment in the system

- **Post-Project-Maintenance**

This comes with other necessities that is done after project must have been handed over to client.

3.3.2.2 Feature Driven Development (FDD)

This methodology was developed by two people: Jeff De Luca and Peter Coad. The strength is in the fact that processes to ensure scalability and repeatability. It also encourages creativity and innovation during development. It is best describe in terms of assertion that:

- A simple, but well-define process will work best.
- “*Process pride*” can keep the real work from happening
- Good processes are moved to background which enables the team member to focus more on results
- Very short, iterative and feature driven life cycle are considered the best
- A system for building systems is necessary in order to scale to larger projects.

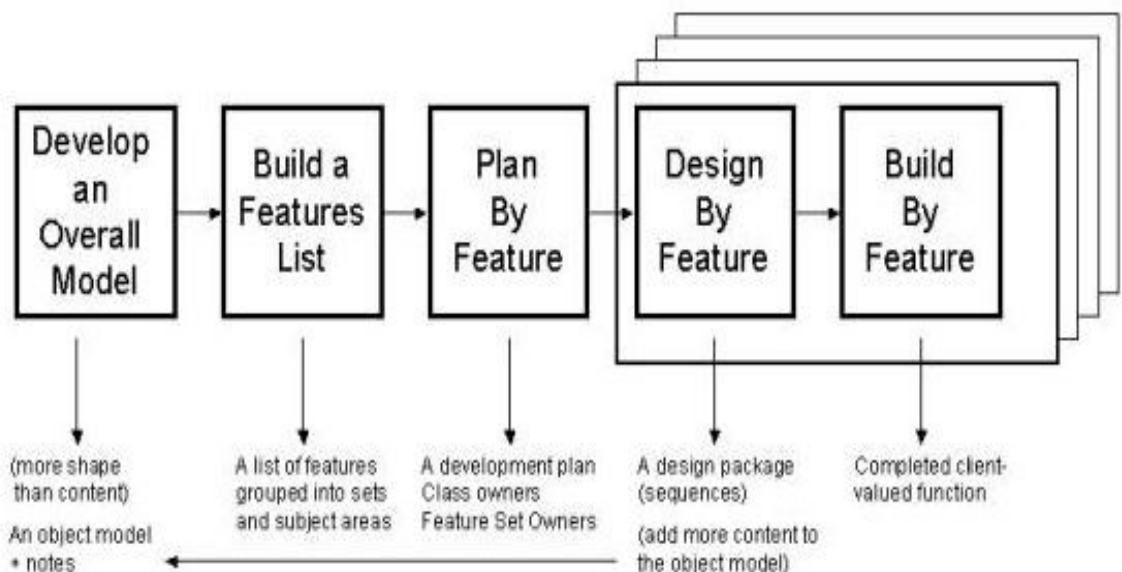


Figure 14 Showing FDD Methodology

Feature driven development has 5 main processes as described by Palmer (2014) which are:

- **Develop an Overall Model**

Palmer (2014) described this processes saying *“it demands that a team invest just enough effort at the beginning of a project in exploring the structure of the problem by building an object model of the problem domain”*. It also described it in terms of cross-functional, collaborative and time boxed activity.

- **Build a Feature List**

Palmer (2014) described this phase as *“the team next constructs the FDD equivalent of an initial, overall product backlog. Instead of user stories or backlog items, FDD talks about features. In FDD, a feature is a small piece of client-valued function expressed in the form: <action> the <result><by|for|of|to> a(n) <object>*

- **Plan by Feature**

To plan by feature simply means to sequence sets of features for a certain type of activities in a way that it fits into a plan and it's further assigned to a developer that would develop them into a program

- **Design by Feature**

This entails designing the proposed system based on its features and functionalities in line with the system requirements

- **Build by Feature**

Building by feature also entails physical development of the proposed system based on its features one after the other.

3.3.2.3 Joint Application Development (JAD)

The Joint Application Development as described by Crosby (2013) saying *“a requirements-definition and user-interface design methodology in which end-users, executives, and developers attend intense off-site meetings to work out a system's details”*. He later went on to further say it *“aims to involve the client in the design and development of an application”*

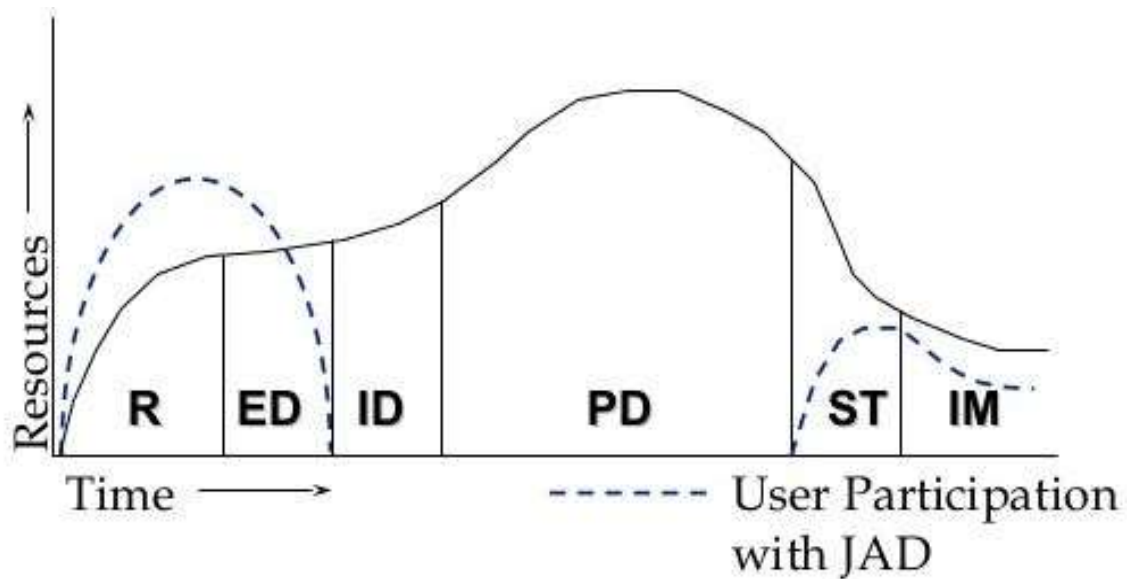


Figure 15 Showing JAD Methodology

The JAD is made up of 6 stages of development which are:

- **Requirements**
This is where both system and user requirements are all generated for the proposed system
- **External Design**
This is where all entities that makes up the system are identified including information flow and system communication
- **Internal Design**
The is referred to as the logical design where the blue print of the proposed system is actually done
- **Program Development**
This stage is where the physical system is done by coding and debugging the program
- **System Testing**
The program written needs to be tested in order to eb sure it meets its specified requirements
- **Installation and Maintenance**
This is where system is migrated to desired environment and further maintained as maintenance is always a continuous process.

3.3.2.4 Rapid Application Development (RAD)

The RAD is best described in an iterative sequence. Ramsoft (2012) was able to explain this methodology saying “*Rapid Application Development (RAD) methodology used minimal planning in favour of rapid prototyping, allowing software to be written faster and makes it easy to change the requirement*”

It has 4 main development phases illustrated in the diagram below

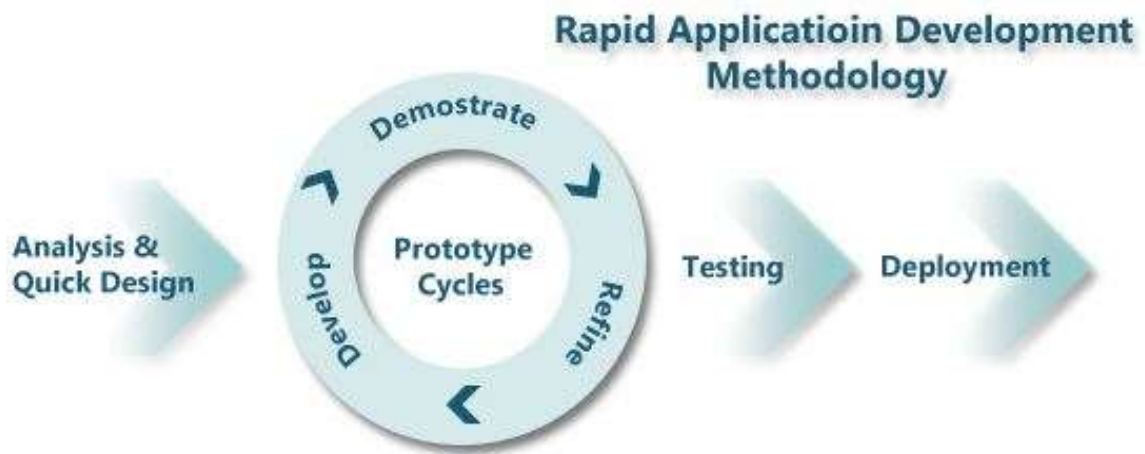


Figure 16 Showing RAD Methodology

Its stages are

- Analysis and Quick Design
- Prototype Cycle
- Testing
- Deployment

3.3.2.5 Rational Unified Processing (RUP)

The RUP is described by Ang (2012) by first saying “*RUP as the acronym states, is a Rational Unified Process which is originally developed by rational developer as a software development methodology*”

He later revealed that “*Based on UML, RUP organizes the development of software into four phases each consisting of one or more executable iterations of the software at that stage of development*”.

This is illustrated below

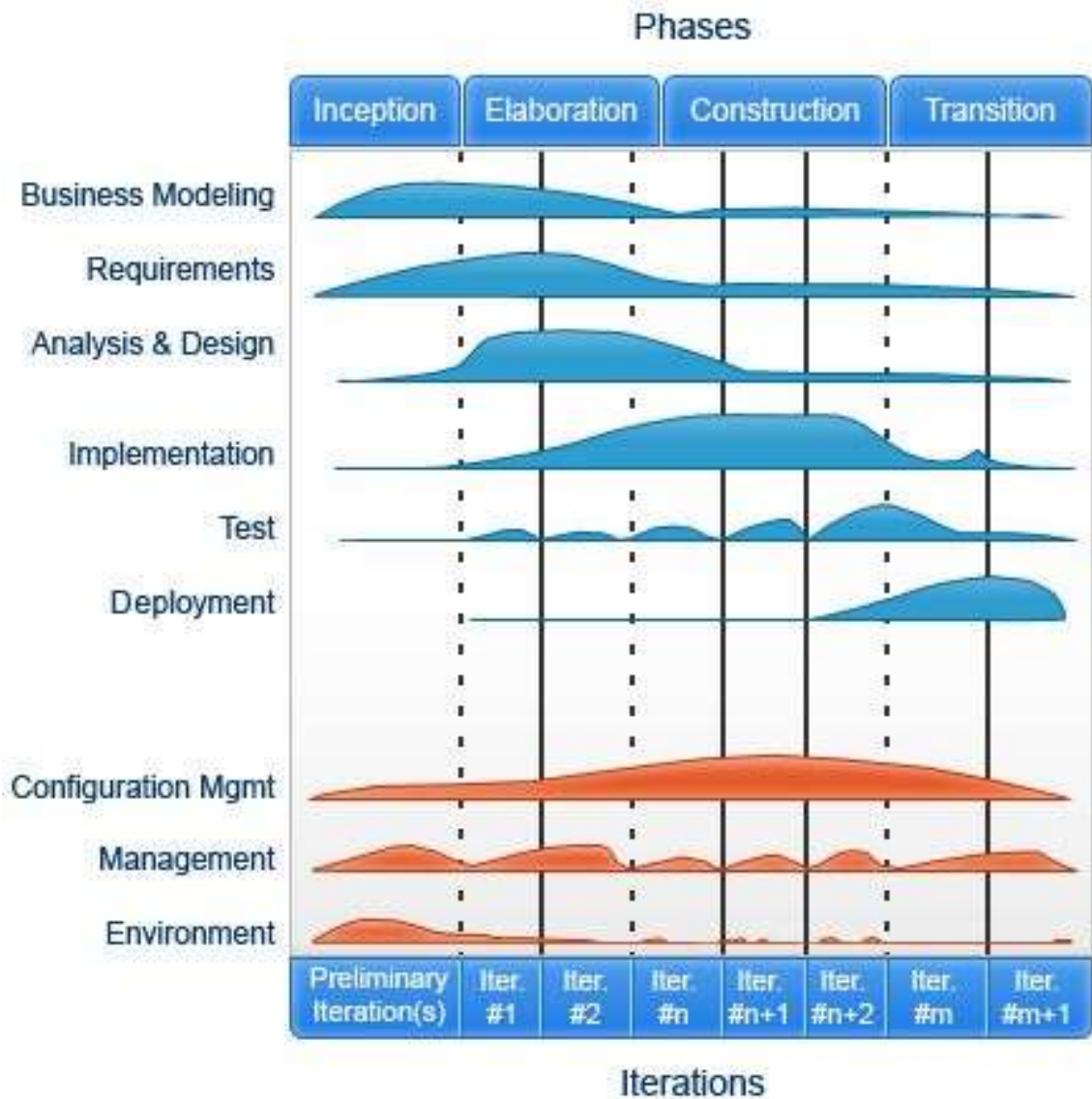


Figure 17 Showing RUP methodology

The RUP shows there are 4 stages involved which are:

- **Inception**

This is where the decision is made by the team involved if the project is feasible or not. It also involves scope and the needed resources

- **Elaboration**

A closer look at the project in terms of architecture and criteria to be used to evaluate the architecture are all done. Risks analysis is also done here while new technologies are also added

- **Construction**

Development is done and completed here with coding done. This stage also involves testing the developed system to see if the requirements have been met

- **Transition**

This is where final adjustment are done to the develop system based on user feedback as well as usability

3.3.3 Justification for System Methodology

The different system methodologies have been examined. They include DSDM, FDD, JAD, RAD as well as RUP. Each of the methodologies have their own respective advantages and nest situation they fit into. A consideration of all eventually led to the decision to use a Hybrid Methodology. This is because each methodology has its own advantage at every project stage. A hybrid can be a combination of just 2 or even more than 5 depending on the developer. For this project, a hybrid of RAD and FDD was used. RAD made it possible and easier to adapt as the developer realised at some point the requirements would change. FDD made it possible to focus on all the features of the system.

3.3.4 Design

The design is done to reflect every process that the doctor engages in in a typical hospital setting as well as other processes that the hospital engages in as it known that doctor cannot just exist on its own in a hospital. The design has also been done using hybrid approach

3.3.5 Implementation

3.3.5.1 Basic System Setup

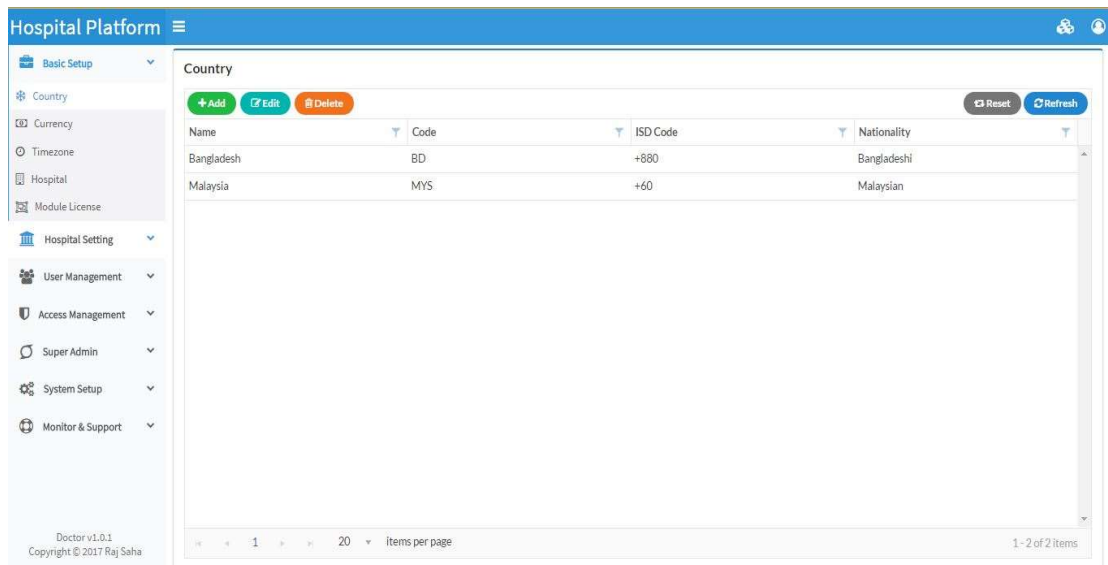


Figure 18 Showing Systems Basic Setup

The First phase is creating the Hospital, A hospital will be under a country and time zone.

3.3.5.2 Hospital Settings

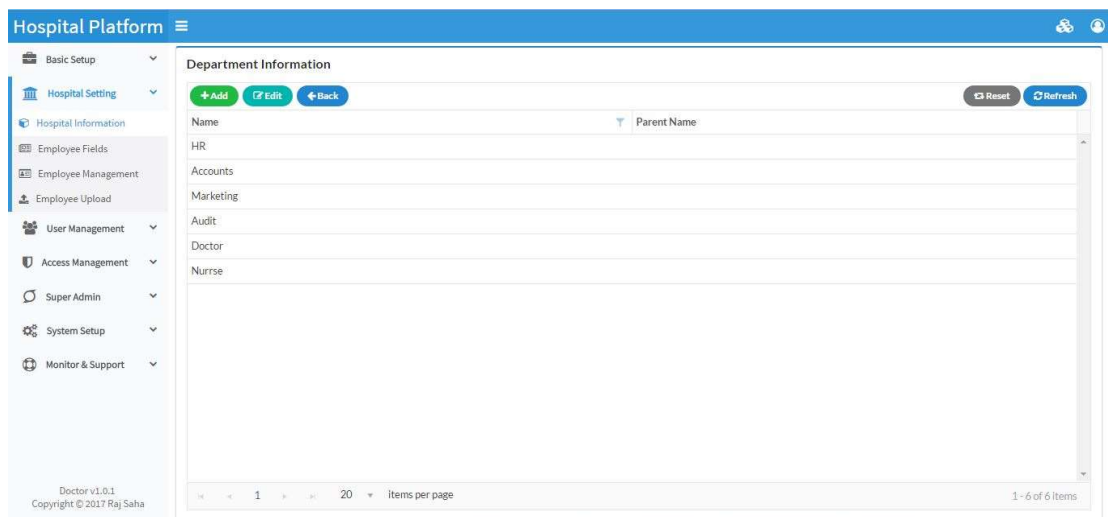


Figure 19 Showing system's Hospital settings

This is where hospital information as well as employee management among other things are done. In this application doctors are treated as employee. While creating Hospital information there is an option to create dynamic fields for each hospital so that they can store some specific information about all doctors which they can use to later on to check what is doctor's preference.

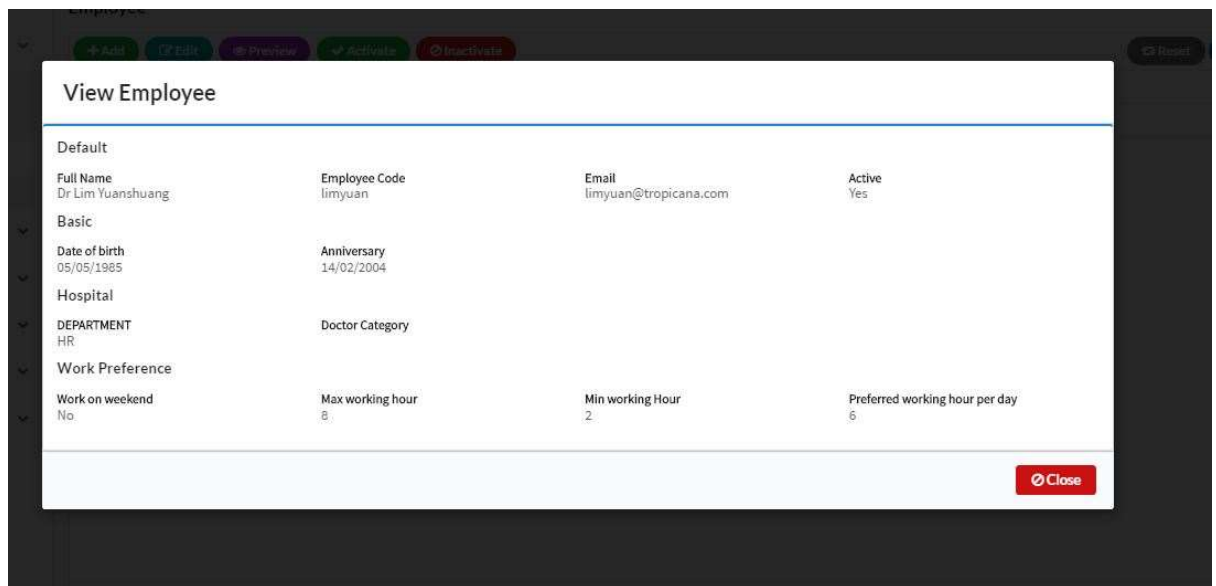


Figure 20 Showing employee detail information

3.3.5.3 User Management

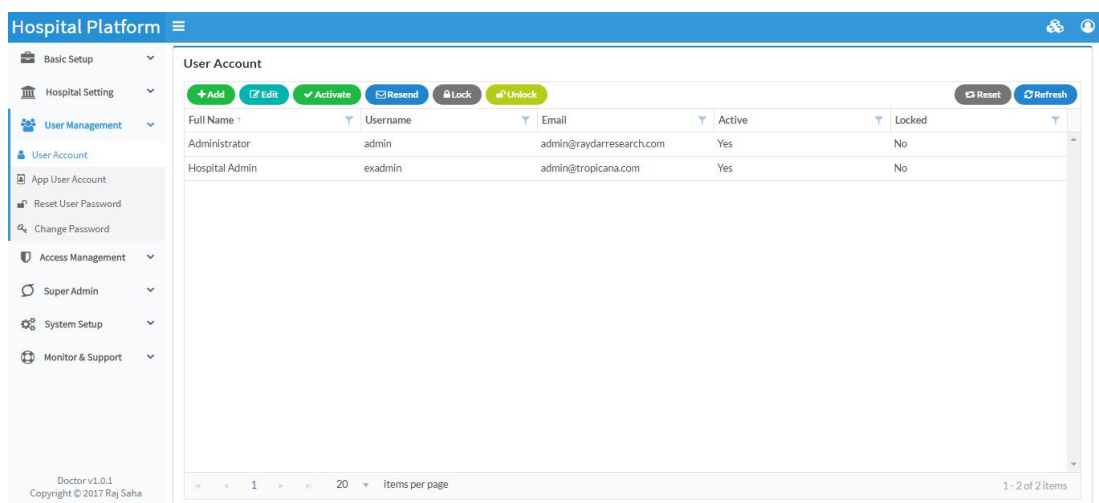


Figure 21 Showing system's user management Panel

The user management panel enables user to manage information regarding to user as well as user account view, password reset and password change

3.3.5.4 Access Management

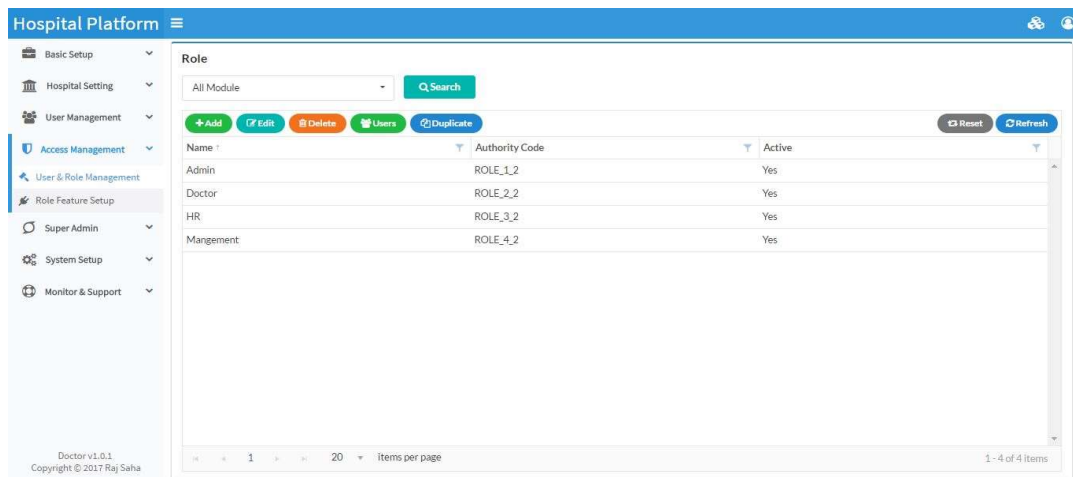


Figure 22 Showing System's Access Management Panel

User of the system can be tracked with their respective status with access management panel as it detailed information of who is logged onto the system and their respective roles

3.3.5.5 System Setup

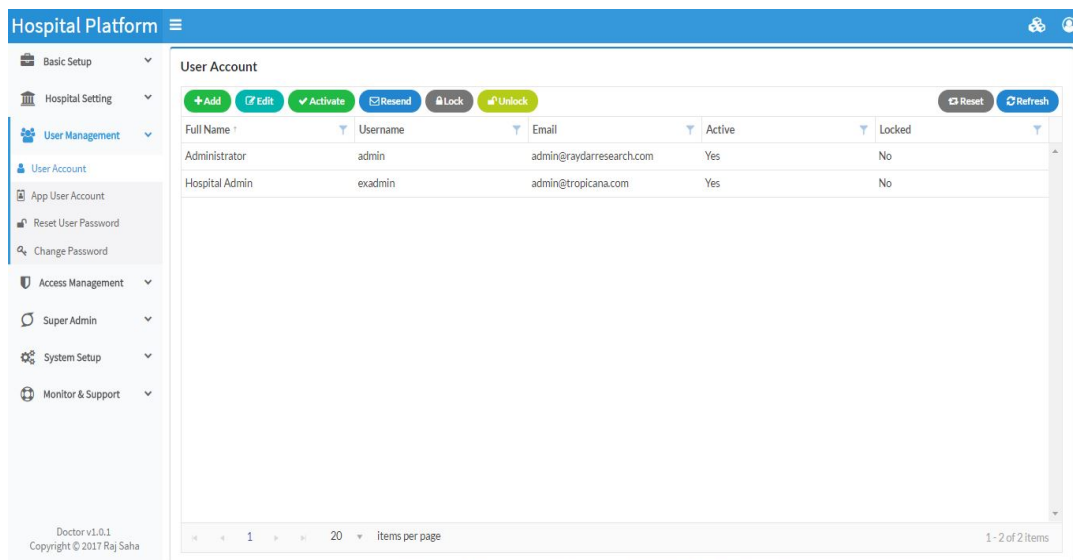


Figure 23 Showing System's Setup Panel

This panel enables the system to be configured to allow functionalities such as system configuration, theme configuration as well as email configuration for general use

3.3.5.6 Monitor and Support

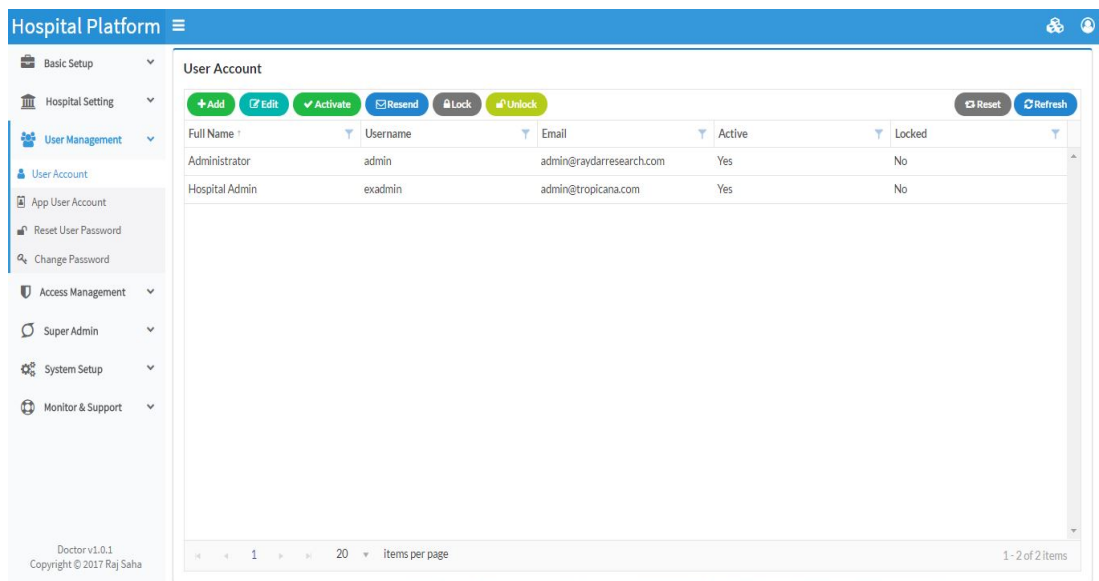


Figure 24 Showing System's Monitor and Support Panel

This panel allow system monitor which a form of security measure. Functionalities that can be carried out include Audits and system logs, ticket support, user feedback as well as monitor system queue.

3.3.5.7 Admin create/update Schedule

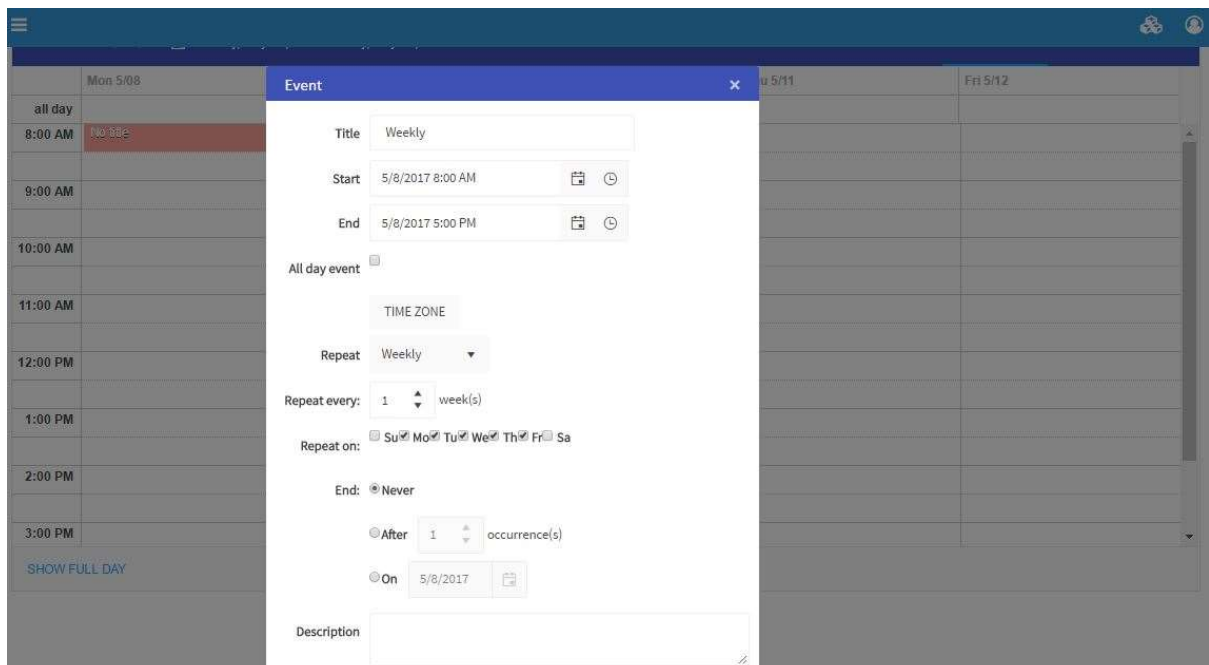


Figure 25 Create/update/delete/ view schedule

From that screen, Admin/management can view all the schedule of all the doctors and create schedule for upcoming days. And changes or new schedule will automatically send notification to doctor.

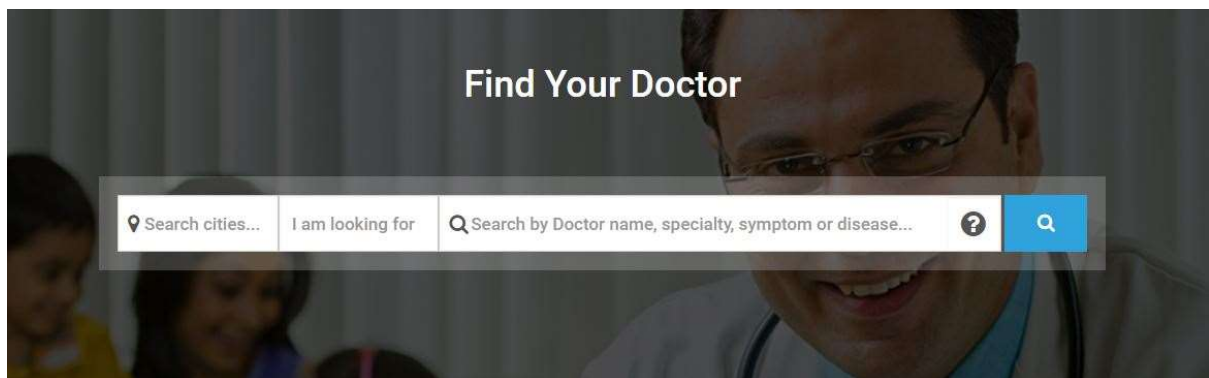
3.3.5.8 Doctor Scheduler View

| TODAY | Monday, May 08, 2017 - Friday, May 12, 2017 | | | | | DAY | WORK WEEK | WEEK | MONTH |
|---------------|---|----------|----------|----------|----------|-----|-----------|------|-------|
| | Mon 5/08 | Tue 5/09 | Wed 5/10 | Thu 5/11 | Fri 5/12 | | | | |
| all day | | | | | | | | | |
| 8:00 AM | | | | | | | | | |
| 9:00 AM | | | | | | | | | |
| 10:00 AM | | | | | | | | | |
| 11:00 AM | | | | | | | | | |
| 12:00 PM | | | | | | | | | |
| 1:00 PM | | No title | | | | | | | |
| 2:00 PM | | | | | | | | | |
| 3:00 PM | | | | | | | | | |
| SHOW FULL DAY | | | | | | | | | |

Figure 26 Showing Doctor's view for the upcoming week

This is calendar view for a doctor where doctor can see their upcoming schedule at a glance and make request for shift/hour change. From here doctor can plan a holiday by seeing his up-coming events.

3.3.5.9 Doctor Search

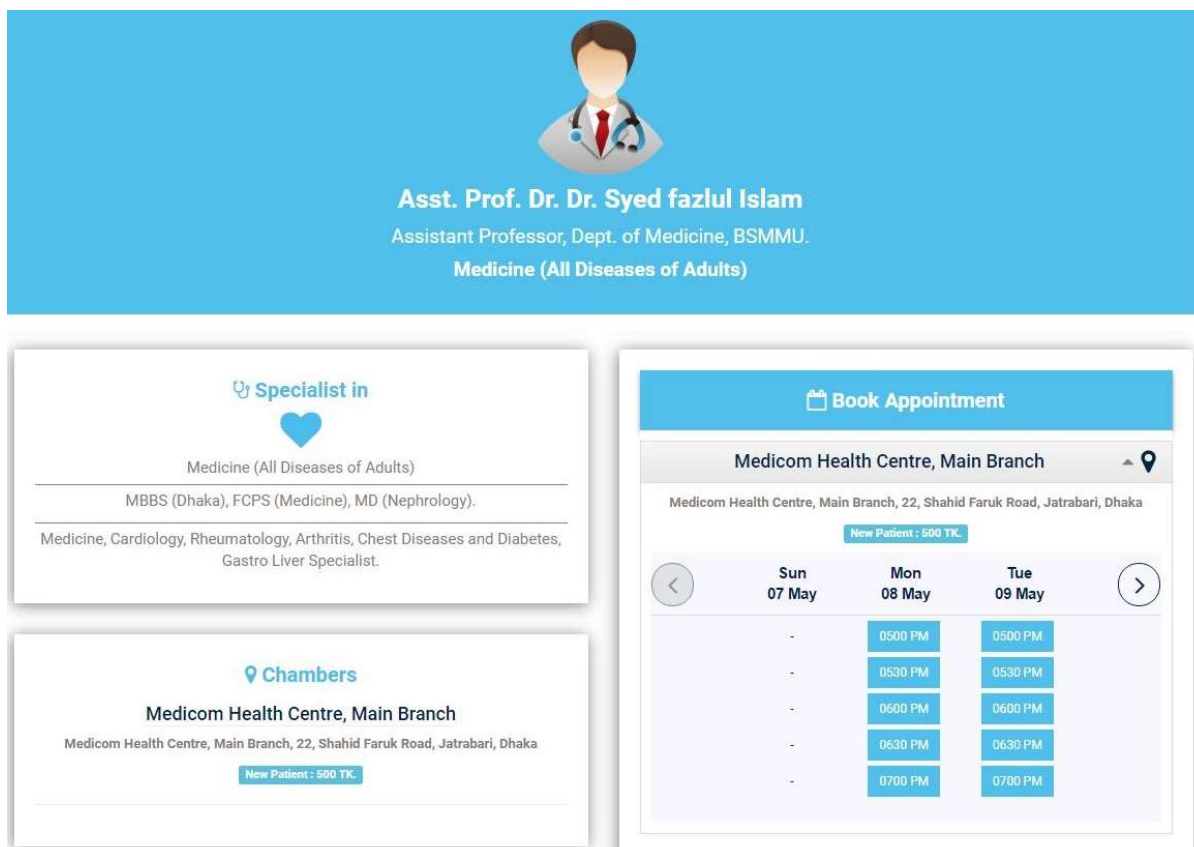


The image shows a 'Find Your Doctor' search interface. It features a header with the text 'Find Your Doctor' and a search bar below it. The search bar is divided into three sections: 'Search cities...' with a location pin icon, 'I am looking for' with a magnifying glass icon, and 'Search by Doctor name, specialty, symptom or disease...' with a question mark icon. A blue search button with a magnifying glass icon is located to the right of the search bar. The background of the interface shows a smiling doctor with a stethoscope.

Figure 27 Doctor Search

This screen is used by general people/patients where they can search doctors by their name, category, disease and even symptom.

3.3.5.9 Doctor Details



The figure displays a user interface for doctor details and appointment booking. The top section features a blue header with a doctor's icon and the following text: **Asst. Prof. Dr. Dr. Syed fazlul Islam**, Assistant Professor, Dept. of Medicine, BSMMU, and Medicine (All Diseases of Adults). Below this, there are two main panels. The left panel, titled 'Specialist in', lists the doctor's qualifications (MBBS (Dhaka), FCPS (Medicine), MD (Nephrology)) and their specialties (Medicine, Cardiology, Rheumatology, Arthritis, Chest Diseases and Diabetes, Gastro Liver Specialist). The right panel, titled 'Book Appointment', shows the location (Medicom Health Centre, Main Branch, 22, Shahid Faruk Road, Jatrabari, Dhaka) and a table of available appointment times for Monday 08 May and Tuesday 09 May. The table lists times from 0500 PM to 0700 PM. A 'New Patient : 500 TK.' label is present in both panels.

| | Sun 07 May | Mon 08 May | Tue 09 May |
|--|------------|------------|------------|
| | - | 0500 PM | 0500 PM |
| | - | 0530 PM | 0530 PM |
| | - | 0600 PM | 0600 PM |
| | - | 0630 PM | 0630 PM |
| | - | 0700 PM | 0700 PM |

Figure 28 Doctor Detail

Once doctor is selected patients can view doctor's details and availability of the doctor. Using the book now button patient can start making the appointment.

3.3.5.10 Request for appointment

Request for Appointment:

Asst. Prof. Dr. Dr. Syed fazlul Islam

Assistant Professor, Dept. of Medicine, BSMMU.

Medicom Health Centre, Main Branch, Jatrabari, Dhaka

Appointment Time : Monday 08 May 2017 on 0600 PM



The figure shows a 'Request for Appointment' form. It includes a question 'Have you visited this doctor before?' with radio buttons for 'Yes' and 'No'. Below this is a 'Mobile No.' field with a dropdown menu showing '+88 01' and a text input field containing '717094921'. A green 'Request Appointment' button is located at the bottom right of the form.

Figure 29 Request for appointment

Patients need to add some basic information and request for an appointment.

3.3.5.11 Confirmation for patients

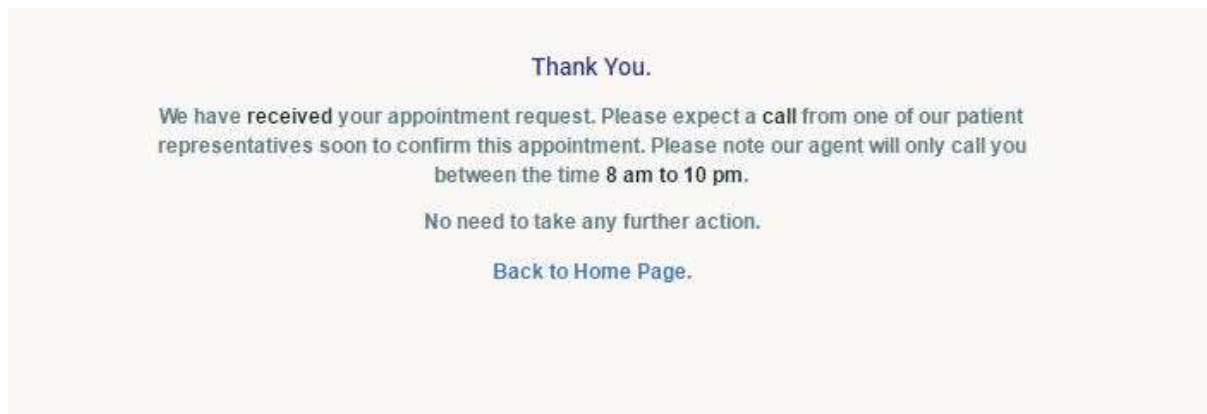


Figure 30 appointment confirmation

Once patients make the request it directly go to doctors and the doctor get to choose how many patients they want to visit because of this the patients don't get direct confirmation.

3.3.5.12 Doctor Appointment Approve



Figure 31 appointment approval

From this screen, Doctor get to choose how many patients they want to see, if they think some number is enough for the day or they have some personal things which is really important they can move an appointment to next available session.

3.3.6 Testing

Testing is a standard procedure that is done to test any system that must have been developed. The type of testing depends on the kind of system that has been built. For this project, three types of testing will be used

- **Unit Testing**

The unit testing will be carried out in order to test every unit of the system to make sure they work the way they have been programmed

- **Black Box Testing**

This will be carried out to see how users respond to using the system for the first time without prior knowledge of what the system does

- **User Acceptance Testing**

This will be carried out by prospective user to see if it has met requirements and can be integrated into the environment for which it has been developed

3.4 SOFTWARE REQUIREMENTS

3.4.1 Operating System

The system was developed on windows Operating System but any operating system has internet and browser can use this application because this is a web based application.

3.4.2 Integrated Development Environment (IDE)

The IDE that was also used is IntelliJ IDEA. It was developed by JetBrains and it was chosen because it provide a very interactive user interface that helps developing user interface very fast and attractive.

3.4.3 Programing Language

The programming language that was used to develop the system is Java Grails 3.3.4. It was formerly referred to as Groovy on rails and is a programming framework that has its roots deep in Ruby on Rails. It has been used because it is highly productive

and it provides necessary API that makes the application easier and more flexible to develop. In addition to this, Gradle was also used in combination Java Grails

3.4.4 *Augmented Reality SDK*

The Software Development Kit that was adopted and use is Java SDK 1.8. Other versions could have been used but the developer decided to use a lower version that would make it run on almost every machine

3.5 TESTING TECHNIQUE

3.5.1 *Unit Testing*

The unit testing was done for all the features and functionalities of the system. the details are given below

| | |
|------------------------|---|
| Test Case ID | UniT 1 |
| Function | Country settings |
| Input | Input country settings as desired |
| Expected Result | System displays added or inputted country details |
| Actual Result | System displays added or inputted country details |
| Tester | Raj |
| Status | Successful |
| Comments | Obtained expected result |

| | |
|------------------------|---|
| Test Case ID | UniT 2 |
| Function | Currency settings |
| Input | Input currency settings as appropriate for each country |
| Expected Result | System displays added or inputted currency details |
| Actual Result | System displays added or inputted currency details |
| Tester | Raj |
| Status | Successful |
| Comments | Obtained expected result |

| | |
|---------------------|--------------------|
| Test Case ID | UniT 3 |
| Function | Time zone settings |

| | |
|------------------------|--|
| Input | Input Time zone settings as appropriate for each country |
| Expected Result | System displays added or inputted Time zone setting |
| Actual Result | System displays added or inputted Time zone setting |
| Tester | Raj |
| Status | Successful |
| Comments | Obtained expected result |

| | |
|------------------------|---|
| Test Case ID | UniT 4 |
| Function | Hospital settings |
| Input | Input hospital settings where appropriate |
| Expected Result | System displays message showing that imputed hospital settings has been added |
| Actual Result | System displays message showing that imputed hospital settings has been added |
| Tester | Raj |
| Status | Successful |
| Comments | Obtained expected result |

| | |
|------------------------|--|
| Test Case ID | UniT 5 |
| Function | Hospital information management |
| Input | update hospital information where appropriate |
| Expected Result | System displays message showing that updated hospital information has been confirmed |
| Actual Result | System displays message showing that updated hospital information has been confirmed |
| Tester | Raj |
| Status | Successful |
| Comments | Obtained expected result |

| | |
|---------------------|---------------------------------|
| Test Case ID | UniT 6 |
| Function | Employee Information Management |

| | |
|------------------------|--|
| Input | update employee information where appropriate |
| Expected Result | System displays message showing that updated employee information has been confirmed |
| Actual Result | System displays message showing that updated employee information has been confirmed |
| Tester | Raj |
| Status | Successful |
| Comments | Obtained expected result |

| | |
|------------------------|--|
| Test Case ID | UniT 7 |
| Function | User Management |
| Display | User management panel is displayed |
| Expected Result | System displays user accounts with their respective status |
| Actual Result | System displays user accounts with their respective status |
| Tester | Raj |
| Status | Successful |
| Comments | Obtained expected result |

| | |
|------------------------|---|
| Test Case ID | UniT 8 |
| Function | Apps User Management |
| Display | User management panel is displayed |
| Expected Result | System displays Apps user accounts with their respective status |
| Actual Result | System displays Apps user accounts with their respective status |
| Tester | Raj |
| Status | Successful |
| Comments | Obtained expected result |

| | |
|---------------------|---------------|
| Test Case ID | UniT 9 |
|---------------------|---------------|

| | |
|------------------------|---|
| Function | Password reset |
| Input | Password reset is initiated |
| Expected Result | System resets user password to the original when user was added to the system |
| Actual Result | System resets user password to the original when user was added to the system |
| Tester | Raj |
| Status | Successful |
| Comments | Obtained expected result |

| | |
|------------------------|--|
| Test Case ID | UniT 10 |
| Function | Password change |
| Input | Password change is initiated |
| Expected Result | System displays window where user can change password and the change is effected |
| Actual Result | System displays window where user can change password and the change is effected |
| Tester | Raj |
| Status | Successful |
| Comments | Obtained expected result |

| | |
|------------------------|---|
| Test Case ID | UniT 10 |
| Function | Access Management |
| Display | Access management panel is displayed |
| Expected Result | System displays window showing all users and their respective authority granted to them |
| Actual Result | System displays window showing all users and their respective authority granted to them |
| Tester | Raj |
| Status | Successful |
| Comments | Obtained expected result |

| | |
|------------------------|---|
| Test Case ID | UniT 11 |
| Function | Role setup |
| Input | User is assigned a role based on level |
| Expected Result | System displays window showing all users and their respective roles |
| Actual Result | System displays window showing all users and their respective roles |
| Tester | Raj |
| Status | Successful |
| Comments | Obtained expected result |

| | |
|------------------------|---|
| Test Case ID | UniT 12 |
| Function | Role setup |
| Input | User is assigned a role based on level |
| Expected Result | System displays window showing all users and their respective roles |
| Actual Result | System displays window showing all users and their respective roles |
| Tester | Raj |
| Status | Successful |
| Comments | Obtained expected result |

| | |
|------------------------|---|
| Test Case ID | UniT 13 |
| Function | System configuration |
| Input | System is configured |
| Expected Result | System displays system configuration confirmation |
| Actual Result | System displays system configuration confirmation |
| Tester | Raj |
| Status | Successful |
| Comments | Obtained expected result |

| | |
|------------------------|--|
| Test Case ID | UniT 14 |
| Function | Theme configuration |
| Input | Theme is configured |
| Expected Result | System displays theme configuration confirmation |
| Actual Result | System displays theme configuration confirmation |
| Tester | Raj |
| Status | Successful |
| Comments | Obtained expected result |

| | |
|------------------------|--|
| Test Case ID | UniT 15 |
| Function | Email configuration |
| Input | Email is configured |
| Expected Result | System displays email configuration confirmation |
| Actual Result | System displays email configuration confirmation |
| Tester | Raj |
| Status | Successful |
| Comments | Obtained expected result |

| | |
|------------------------|------------------------------|
| Test Case ID | UniT 15 |
| Function | Audit Log Management |
| Display | Audit Log panel is displayed |
| Expected Result | System displays audit logs |
| Actual Result | System displays audit logs |
| Tester | Raj |
| Status | Successful |
| Comments | Obtained expected result |

| | |
|------------------------|-------------------------------|
| Test Case ID | UniT 16 |
| Function | System Log Management |
| Display | System Log panel is displayed |
| Expected Result | System displays System logs |

| | |
|----------------------|-----------------------------|
| Actual Result | System displays System logs |
| Tester | Raj |
| Status | Successful |
| Comments | Obtained expected result |

| | |
|------------------------|-----------------------------------|
| Test Case ID | UniT 17 |
| Function | Ticket Management |
| Display | Support Ticket panel is displayed |
| Expected Result | System displays list of tickets |
| Actual Result | System displays list of tickets |
| Tester | Raj |
| Status | Successful |
| Comments | Obtained expected result |

| | |
|------------------------|------------------------------------|
| Test Case ID | UniT 18 |
| Function | User Feedback Management |
| Display | User Feedback Panel is displayed |
| Expected Result | System displays all user feedbacks |
| Actual Result | System displays all user feedbacks |
| Tester | Raj |
| Status | Successful |
| Comments | Obtained expected result |

| | |
|------------------------|--|
| Test Case ID | UniT 19 - 1 |
| Function | Login |
| Input | User inputs wrong login details |
| Expected Result | System displays error asking to re-enter correct login details |
| Actual Result | System displays error asking to re-enter correct login details |
| Tester | Raj |
| Status | Successful |
| Comments | Obtained expected result |

| | |
|------------------------|--|
| Test Case ID | UniT 19 - 2 |
| Function | Login |
| Input | User inputs correct login details |
| Expected Result | System displays successful login and redirects users to landing page |
| Actual Result | System displays successful login and redirects users to landing page |
| Tester | Raj |
| Status | Successful |
| Comments | Obtained expected result |

3.5.2 Black Box Testing

The black box testing was carried out to see how users respond to using the system for the first time without prior knowledge of what the system does. A total of 18 correspondence participated and the results is given below:

| Criteria/ Tester | Design | Layout | Navigation | Content | Interactivity |
|--|--------|--------|------------|---------|---------------|
| 1 | 4 | 4 | 4 | 5 | 4 |
| 2 | 4 | 4 | 4 | 4 | 4 |
| 3 | 5 | 4 | 4 | 4 | 4 |
| 4 | 4 | 4 | 4 | 4 | 4 |
| 5 | 4 | 4 | 4 | 4 | 4 |
| 6 | 5 | 4 | 4 | 4 | 4 |
| 7 | 4 | 4 | 4 | 4 | 4 |
| 8 | 5 | 4 | 5 | 5 | 4 |
| 9 | 4 | 4 | 5 | 4 | 4 |
| 10 | 5 | 4 | 4 | 4 | 4 |
| 11 | 4 | 4 | 4 | 4 | 4 |
| 12 | 4 | 4 | 4 | 4 | 4 |
| 13 | 5 | 4 | 4 | 4 | 4 |
| 14 | 4 | 4 | 3 | 4 | 4 |
| 15 | 5 | 3 | 4 | 4 | 4 |
| Total | 78/90 | 70/90 | 73/90 | 74/90 | 71/90 |
| Percentage | 87% | 78% | 81% | 82% | 79% |
| Average Percentage = 81.4% | | | | | |
| Percentage Pass = 74% | | | | | |
| Keys: 5 = Excellent 4 = Very Good 3 = Good 2 = Average 1 = Fair | | | | | |

Table 1 Showing Black Box Testing

3.5.3 User Acceptance Testing

The user acceptance testing as carried out by prospective user to see if it has met requirements and can be integrated into the environment for which it has been developed. A total of 11 correspondence participated and the results are given below:

| Criteria/ User | System Logic | System Response | System Architecture | System Flexibility | Ease of Use |
|---|-----------------|--------------------|------------------------|-----------------------|----------------|
| 1 | 4 | 4 | 4 | 4 | 5 |
| 2 | 4 | 4 | 4 | 4 | 5 |
| 3 | 4 | 4 | 4 | 4 | 4 |
| 4 | 4 | 4 | 5 | 4 | 5 |
| 5 | 4 | 4 | 4 | 4 | 4 |
| 6 | 4 | 4 | 4 | 4 | 5 |
| 7 | 4 | 4 | 4 | 4 | 4 |
| 8 | 4 | 4 | 4 | 4 | 5 |
| 9 | 4 | 4 | 5 | 4 | 5 |
| 10 | 3 | 4 | 4 | 4 | 5 |
| 11 | 4 | 4 | 4 | 4 | 4 |
| Total | 43/55 | 44/55 | 46/55 | 44/55 | 51/55 |
| Percentage | 78% | 80% | 84% | 80% | 93% |
| Average Percentage = 83% | | | | | |
| Percentage Pass = 80% | | | | | |
| Keys: 5 = Very Good 4 = Good 3 = Average 2 = Fair 1 = Poor | | | | | |

Table 2 Showing User Acceptance Testing

3.5.4 Chosen Test Plan and Justification

The unit testing was chosen in order to be able to test every unit of the system before considering deployment. This gives the user the chance to debug every error the system might have. The black box testing enables the developer to observe how user feels when using the system for the first time with no knowledge of what it does and how it is supposed to work.

This is very important as it helps the developer gather info about issues such as ease of use, navigation and interactivity. The user acceptance is to engage the prospective users to test the system with prior knowledge of how it should work.

4.0 ANALYSIS

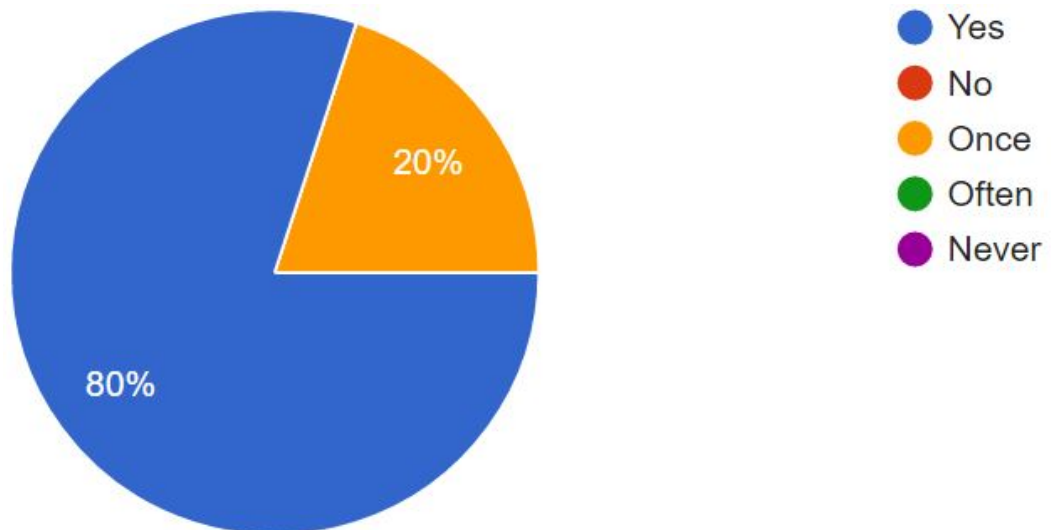
4.1 INTRODUCTION

The research methodology done earlier was to gather information that would help in developing the proposed system. The results from the exercise have been analysed and the details are given in form of analysis.

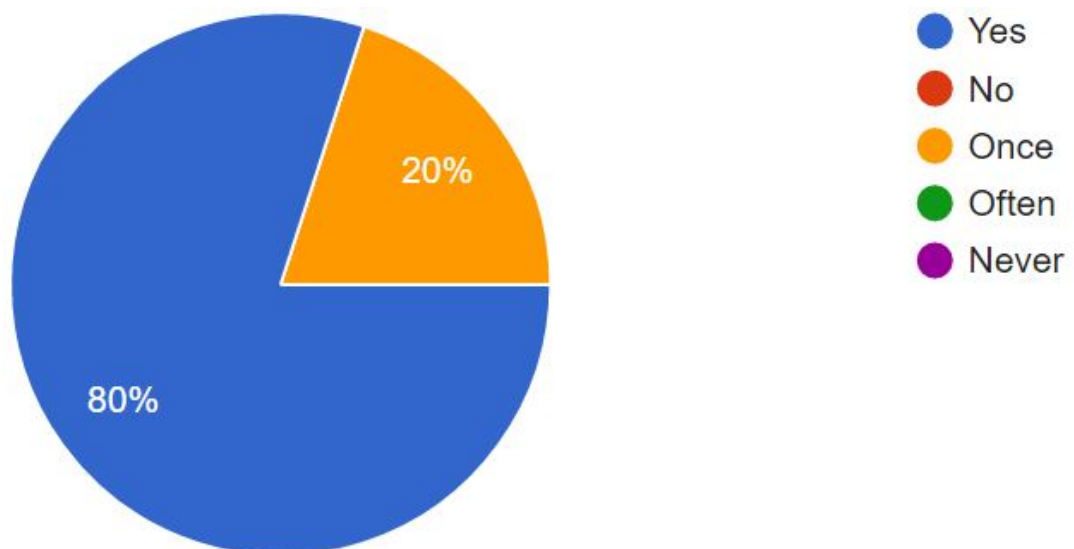
4.2 QUESTIONNAIRE

For the questionnaire, a total target population 25 was made but eventually, only 21 made it through and the results are given below

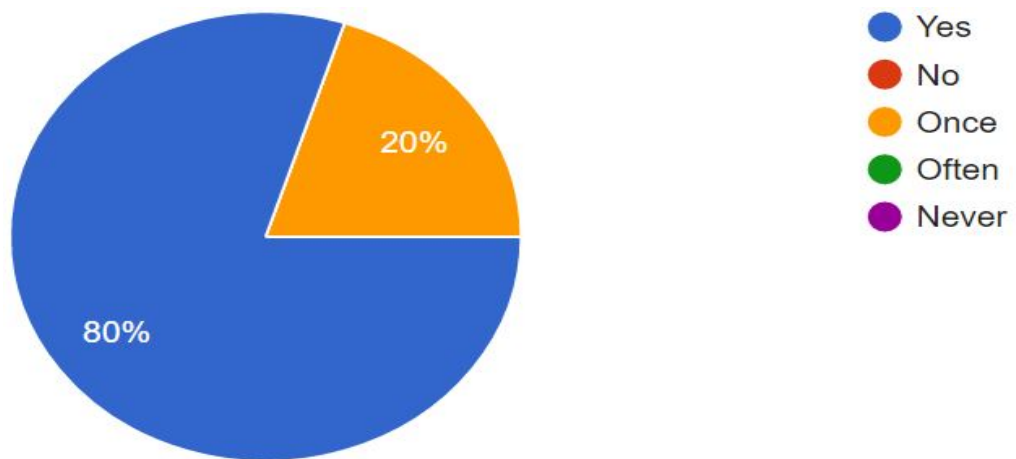
1. Have you ever used an online system before?



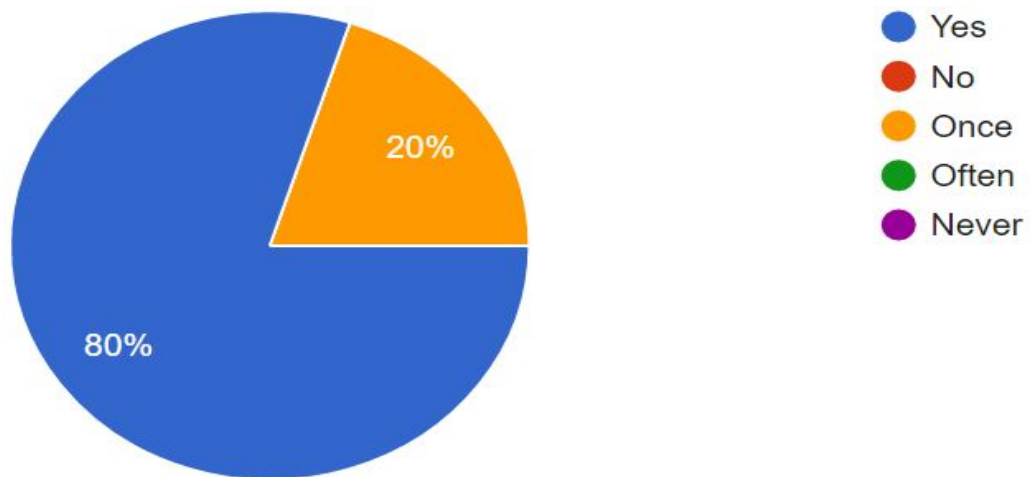
2. Have you ever used a system similar to Doctor's Scheduling System?



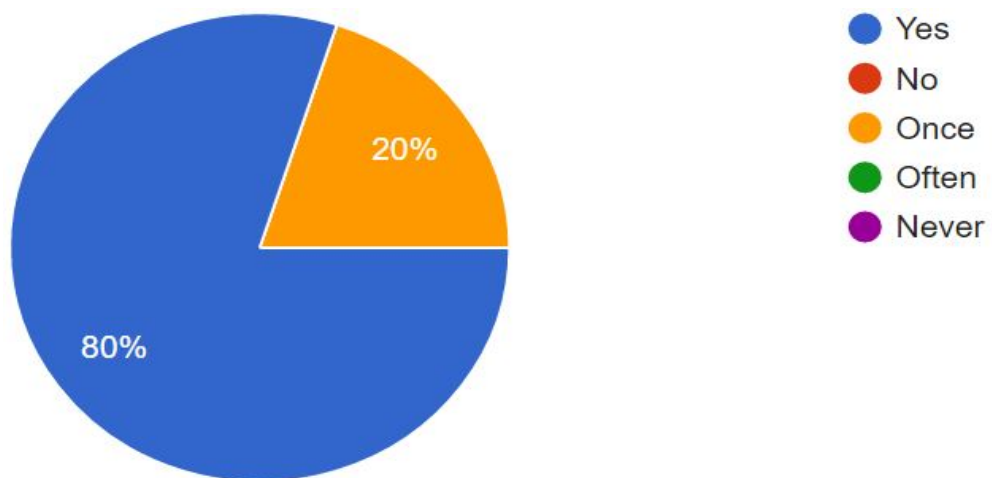
3. Do you think there is a need for this kind of system?



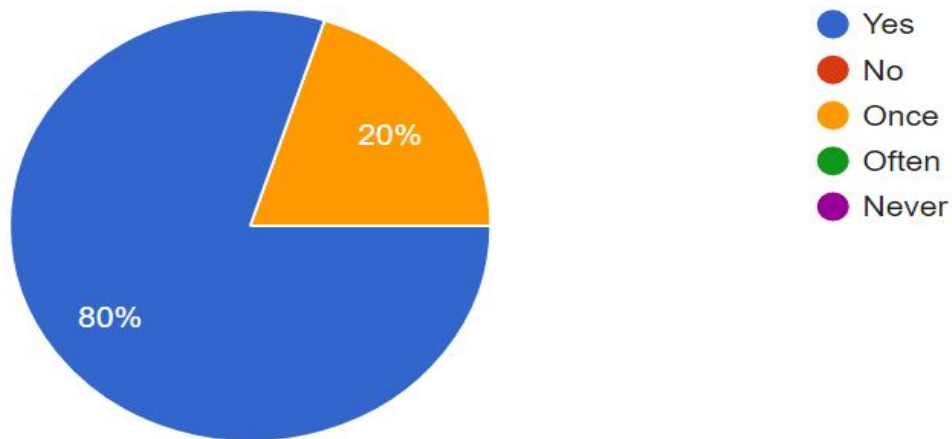
4. In terms of cost do you think it's strategic for any hospital to fund the development and implementation of the Doctor's Scheduling System?



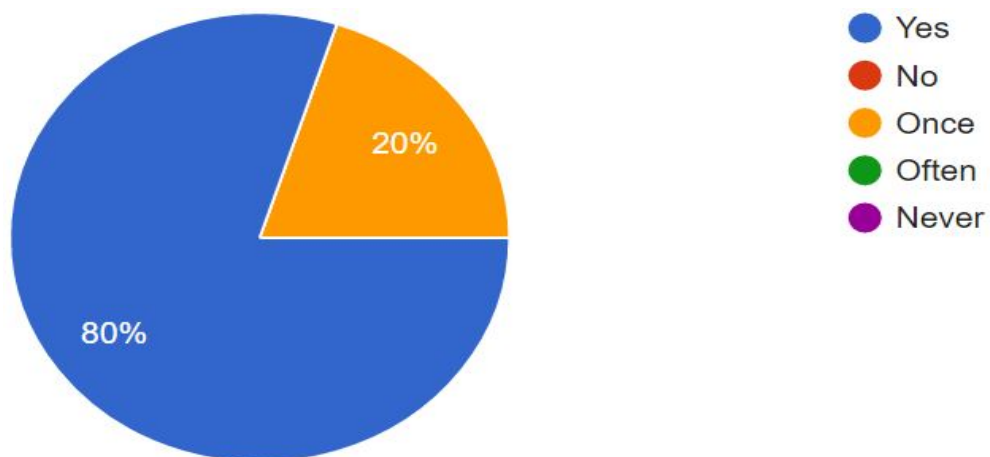
5. In terms of hospital management, do you think implementing a system such as Doctor's Scheduling System is wise?



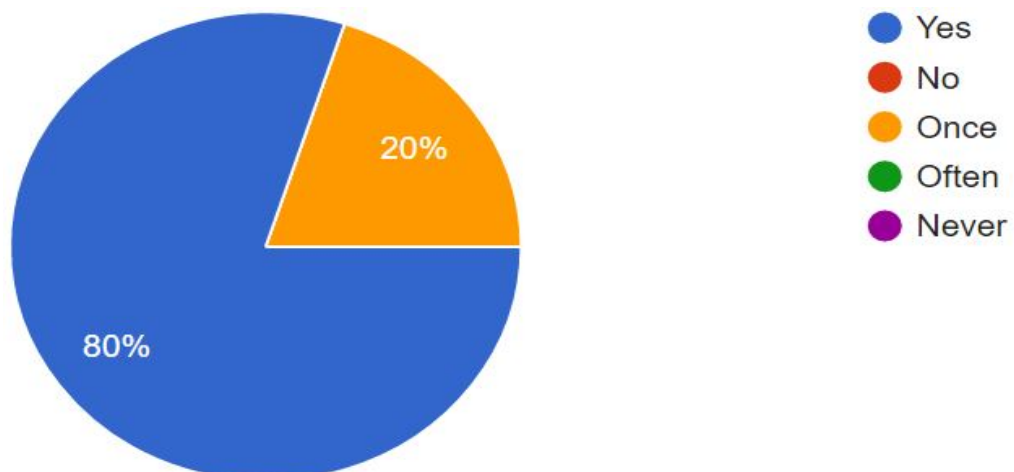
6. Do you think implementing a system such as Doctor's Scheduling System will make doctors job a lot easier?



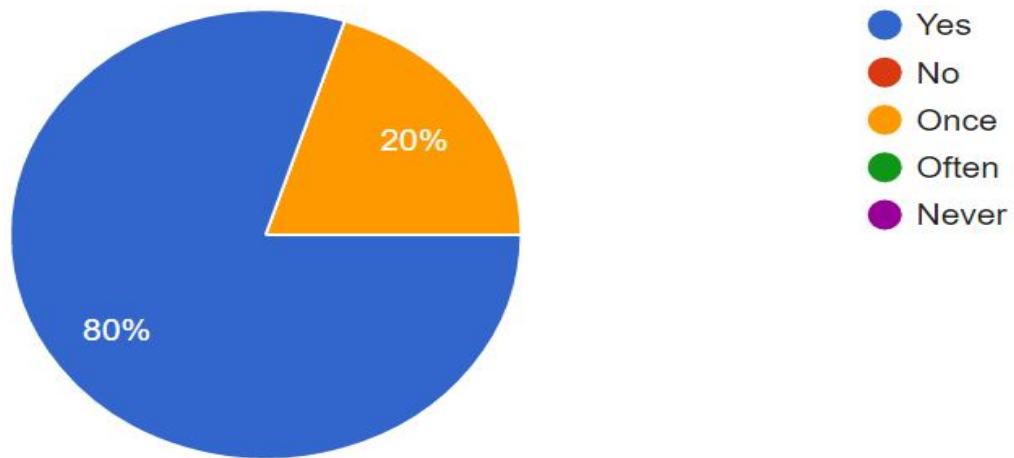
7. Do you think implementing a system such as Doctor's Scheduling System will make doctors job a lot harder?



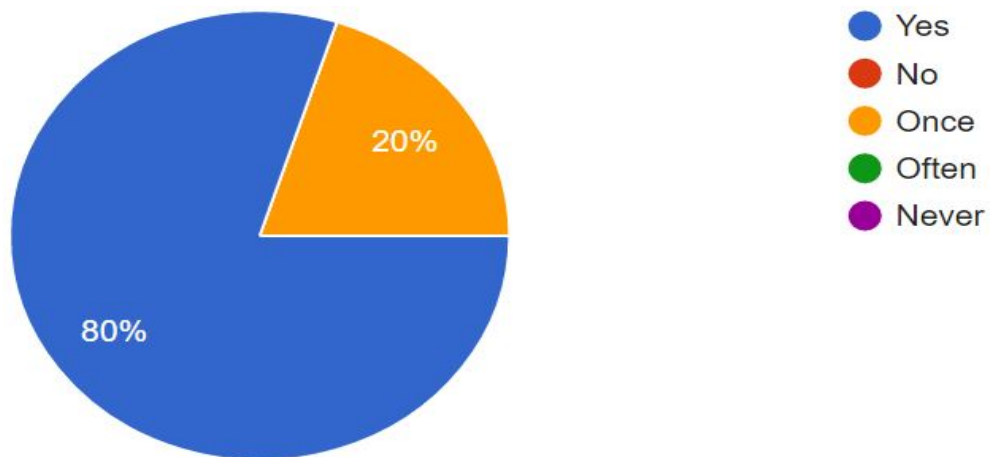
8. Do you think implementing a system such as Doctor's Scheduling System will have a positive effect on other processes in the hospital?



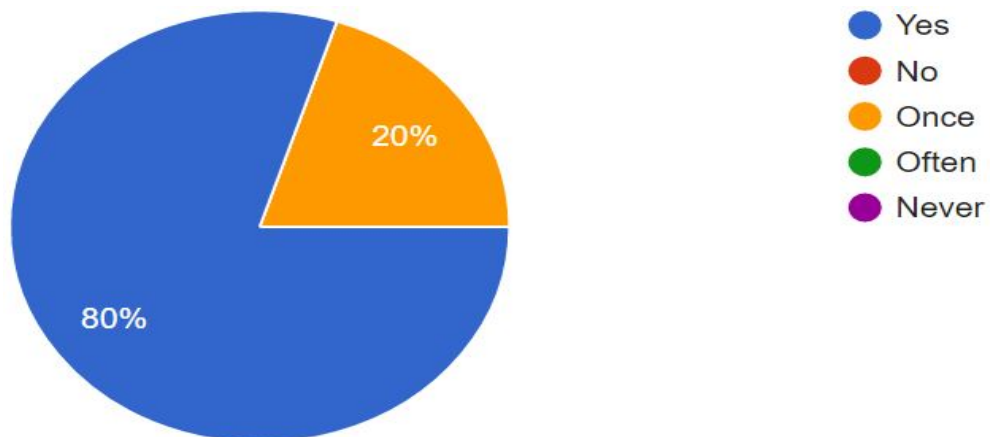
9. Do you think implementing a system such as Doctor's Scheduling System will have a negative effect on other processes in the hospital?



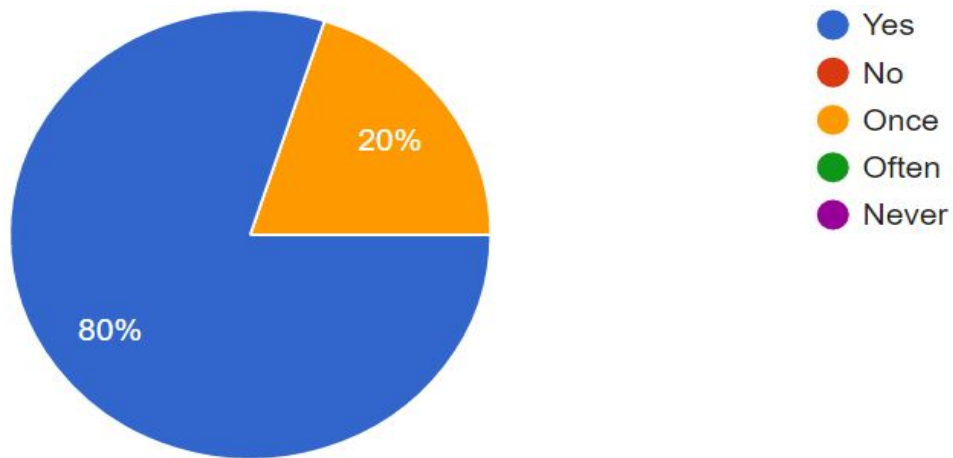
10. Do you think implementing a system such as Doctor's Scheduling System makes it easier to manage hospital general information?



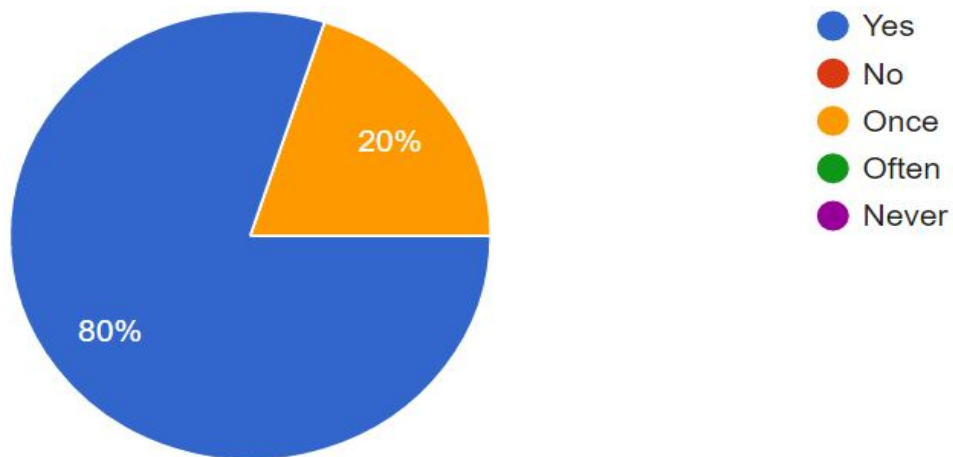
11. Do you think implementing a system such as Doctor's Scheduling System makes it harder to manage hospital general information?



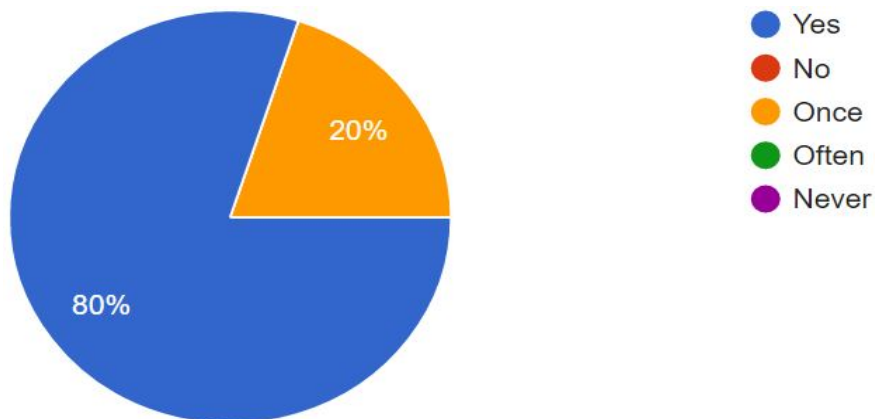
12. Do you think the system is safe enough to be implemented considering the kind of information it would store and handle on a daily basis?



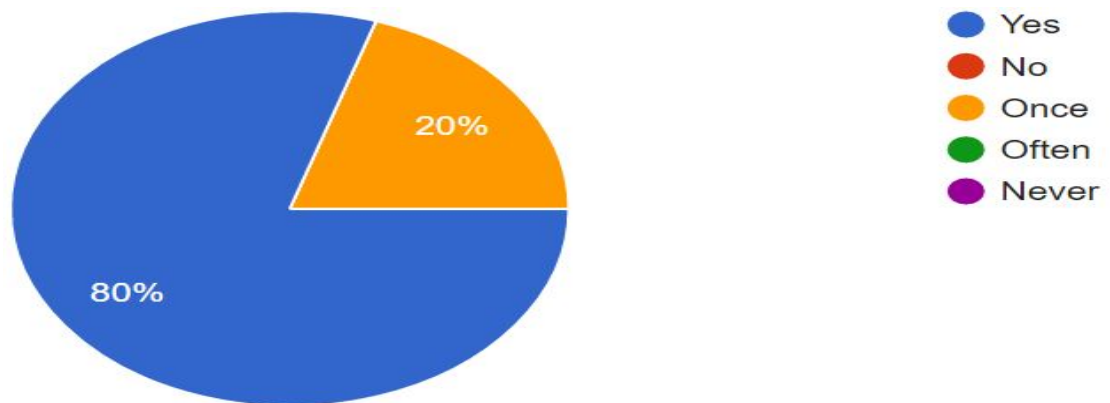
13. Do you think implementing a system such as Doctor's Scheduling System will increase doctor's performance?



14. Do you think implementing a system such as Doctor's Scheduling System will bring more motivation for doctors and other hospital employees?



15. What is your expectation about the Doctor's Scheduling System?



The analysis obtained from the feedback is as follows

1. About 80% of total population have used and online system before, remaining 20% have used it once. This means most correspondence are familiar with
2. At least have of total population have also used an online system similar to the Doctor's Scheduling System which further confirms familiarity. More than half of the remaining population have used it once before
3. About 90% of total population agree and totally agree to the fact that a system such as the Doctor's Scheduling System is needed across hospitals
4. 90% of total population agree and totally agree to the fact that its strategic for any hospital to fund the development and implementation of the Doctor's Scheduling System
5. All the population agree and totally agree to the fact that implementing a system such as Doctor's Scheduling System is wise
6. All the total population agree and totally agree to the fact that implementing a system such as Doctor's Scheduling System will make doctors job a lot easier
7. 90% of total population disagree and totally disagree with the fact that implementing a system such as Doctor's Scheduling System will make doctors job a lot harder
8. Total population agree and totally agree to the fact that implementing a system such as Doctor's Scheduling System will have a positive effect on other processes in the hospital
9. 90% of total population disagree and totally disagree to the fact that implementing a system such as Doctor's Scheduling System will have a negative effect on other processes in the hospital

10. All population agree and totally agree to the fact that implementing a system such as Doctor's Scheduling System makes it easier to manage hospital general information
11. 90% of total population disagree and totally disagree to the fact that implementing a system such as Doctor's Scheduling System makes it harder to manage hospital general information
12. All population agree and totally agree to the fact that the system is safe enough to be implemented considering the kind of information it would store and handle on a daily basis
13. All population agree and totally agree to the fact that implementing a system such as Doctor's Scheduling System will increase doctor's performance
14. All population agree and totally agree with the fact that implementing a system such as Doctor's Scheduling System will bring more motivation for doctors and other hospital employees
15. About 60% of total population have expectation that the system should be simple but comprehensive enough. 20% of the remaining population have expectation that the system should have features that covers all doctors' processes in a typical hospital.

4.3 INTERVIEW

The interview session took place via skype and the list of question was sent to the correspondent. The interview is Mr. Lawal, CEO of SkyLyn Technologies, a subsidiary of SkyLyn Group of Company. The details of the interview is given below

Question: Can you describe the Doctor's Scheduling System based on features?

Answer: I see a lot of features as it is an information system that would manage among other thing, doctors scheduling, appointment and other user related processes. So I expected the following features to be present

- Login
- Registration
- Data manipulated

- Managerial functionalities
- Reports or charts

It might be more than this, it all depends on the developer's preference. The developer's preference also should depend on the requirements of the system to be developed

Question: Can you outline how best to generate requirements for a proposed system?

Answer: This can be best answered from a developer's point of view. User requirements defines what any user of the system can do. This means one thing: system features. The steps to generate user requirements might involve:

- Identify the active users
- Identify passive users
- Identify data that each user would work with
- Convert each active users data usage to requirement
- Convert passive users data usage into requirements
- Convert user requirement into system features

There might be variations in the steps, but I believe these listed above forms the bedrock for generation of system requirements

Question: Can you suggest a suitable methodology for the proposed system?

Answer: In reality, there is nothing like the suitable methodology, all the developer needs to do is focus on his requirements. System requirements have a way of influencing the kind of methodology that would work in order for the requirements to be met. There are a lot of system methodologies and here are some in concise forms.

Dynamic System Development Model Methodology (DSDM): Developed in the UK in the 90's, it is an evolution of rapid

application development practice. Its strength lies in the support training that comes with it as well as documentation techniques which has made it stand out of so many. According to Association of Modern Technologies. DSDM is made up of five main stages which are:

1. Pre – Project
2. Functional Model
3. Design and Build
4. Implement, Deploy and Maintain
5. Post – Project – Maintenance

Extreme Programming Methodology (XP):The XP is a methodology that is used for creating software within an unstable environment as it allows high flexibility within the modelling process. It is made up of four stages which are:

1. Exploration Phase
2. Planning Phase
3. Iteration to Release Phase
4. Production Phase

Feature Driven Development Methodology (FDD): It has just enough processes to ensure scalability and repeatability as it encourages creativity and innovation during development. Feature Driven Development is made up of four processes which are:

1. Develop an Overall Model
2. Build a Feature List
3. Plan by Feature
4. Design and Build by Feature

Joint Application Development Methodology (JAD): This is a requirements-definition and user-interface design methodology in which end-users, executives, and developers attend intense off-site meetings to work out a system's details. Its aims to involve the client in the design and development of an application. It is made up of six stages which are”

1. Requirements
2. External Design
3. Internal Design

4. Program Development
5. System Testing
6. Installation and Maintenance

Rapid Application Development (RAD): Rapid Application Development (RAD) methodology used minimal planning in favour of rapid prototyping, allowing software to be written faster and makes it easy to change the requirement. It is made up of seven stages:

1. Analysis and quick design
2. Prototype cycles
3. Develop
4. Demonstrate
5. Refine
6. Testing
7. Deployment

Rational Unified Processing (RUP): It was originally developed by rational developer as a software development methodology. It organizes the development of software into four phases each consisting of one or more executable iterations of the software at that stage of development. The four stages are:

1. Inception
2. Elaboration
3. Construction
4. Transition

Spiral Methodology: This is based on the premise that software development projects work best when they are both incremental and iterative. The model has four phases:

1. Planning
2. Risk Analysis
3. Engineering
4. Evaluation

Waterfall: This methodology focuses more on the requirements and design being correct. It is mainly made up of five main phases namely:

1. Requirements

2. Design
3. Implementation
4. Verification
5. Maintenance

Prototyping: Prototyping is an easily modified and extensible model of planned software system, likely including its interface and input or output functionality. It is made of four main phases:

1. Requirement Gathering
2. Quick Analysis and Design
3. Development and Implementation
4. Testing

System Development Life Cycle (SDLC): The System Development Life Cycle is a conceptual model used in project management, usually used to describe the stages involved in an Information System. It is made up of five main phases namely:

1. Requirement
2. Analysis
3. Design and Development
4. Implementation
5. Maintenance

Question: Can you suggest a suitable developmental platform for the proposed system?

Answer: This if am not mistaken, refers to the programming language that can be used for the development of the proposed system. Again, emphasis is on “**suitable**”. There is no such thing as suitable programming language to develop a system but what needs to be taken into consideration are:

- The system requirements
- The user requirements
- Language libraries and API's
- Language support

A number of programming languages are available and can be explored. These are

- Java
- C#
- Visual Basic
- Python
- PHP
- C++
- Ruby

Question: Can you suggest a suitable database for the storage of information for the proposed system?

Answer: Just as I answered for the programming language, there is no such thing as “suitable database”. Every database has its own strength as well as limitations but most times, the database to be used always has a high impact on the selection on the front end as well and vice versa. This means the front end application to be used also determines the database that goes with it. This is because over time, these databases have been used with specific front ends and their issues arising have been resolved over time. Using some combinations of databases and front end would just continue to give problems and issues with no visible solutions

The most common databases are:

- Access
- Oracle
- SQL
- MySQL

For the combination of both database and front end

- VB and SQL, Access, MySQL, Oracle
- PHP and MySQL, SQL
- Java and SQL, Access, Oracle

- Python and MySQL
- Ruby and MySQL

These are the most common combinations of both database and front end, this is not to say any other combination won't work; it might result in issues and eventually would not work

Question: Can you suggest a suitable framework for the proposed system?

Answer: There is no suitable framework but what I will suggest is that the methodology that has been used to develop the system must be given a closer look. It all depends on developer's preference. These steps I would strongly recommend.

- Problem Identification
- Feasibility study
- Research
- Data gathering and analysis
- Logical design
- Physical design
- Implementation and Testing
- Integration
- Documentation

There could be variations, this forms the bedrock

Question: Can you identify possible threats that may be encountered in the process of developing the proposed system and how to resolve them?

Answer: Usually if everything goes well with the development, there shouldn't be any drawbacks. However, one cannot predict what could happen during development. Here are some general problems that could be encountered during development. Note that some problems are peculiar to some systems

- **Unclear Goal Definition**

Not clearly defining the goals and objectives to be achieved could lead to lack of corporation with the developmental team. Setting goals and objectives clearly at the start of any system development makes everything easy and straightforward.

- **Undeclared functions**

Not clearly defining the functions to be included in the system would definitely lead to specifications and requirements re-review a number of times. This means the developmental team would just be biting around the bush.

- **Unclear Methodology**

Not clearly identifying the developmental methodology to be implemented can cause a long delay and even confusion. This is because a methodology gives you a clear framework of the developmental stages that needs to be fulfilled in the development of the system

- **Budget**

Budget might be low and realistic for the system to reach its full potential. This means there would be breaks in the execution of the project as it all depends on how cash flow in. this must be addressed right from the start in order to avoid delays in the future.

- **Dedicated Staff**

Shortage of staff to dedicated time to work on the system. Lack of staff dedicated to the development of the system can be a real setback.

- **Changing Time**

Time frame might be too short for the system to be completed. There is always a need to add more time for a project to be executed. This is because of unforeseen circumstances that might occur during the development of the system which might cause some delays

- **System testing and coding.**

This is the most common problem. Coding and debugging are something a developer cannot run away from. Codes would always give errors from time to time and this needs to be welcome as it shows one is on the right track.

Question: Can you outline the suitable test plans for the proposed system?

Answer: A test plan can also be called test driven development in which a programmer developing a system test functionalities, units, modules of a system this is an international standard for testing developed system. For every system developed, there are basic test plans that should be carried out. There are about 14 basic test plans that I would suggest every system should undergo. These are:

1. **Black Box Test:** Done to test user's reaction when using the system for the first time with no prior knowledge of how it is supposed to work
2. **Acceptance Test:** Done to determine if the system satisfies its acceptance criteria and to further determine if the system will be accepted
3. **Compatibility Test:** Done to determine how the system performs on different platforms
4. **Unit Test:** Done to test each and every individual component of the system to make sure they are fit for use
5. **White Box Test:** Done to test the internal logic of the system as well as system codes, branches, paths and conditions.
6. **Globalization testing:** Done to check for proper functioning of the system with regards to local settings and international input directory.
7. **Integration Testing:** Done to test all the modules that make up the system. Modules are made up of smaller system units
8. **Performance Test:** Done to evaluate the compliance of the system with the specified performance requirements
9. **Requirement Testing:** Done to which validate that the requirements are correct, complete, unambiguous and are logically consistent

10. **Security Test:** Done to test if the system really protects its data and maintains its functionalities as intended
11. **Smoke Test:** Done to examine all the different components of the system and to make sure they work properly
12. **Usability Test:** Done to measure the ease with which a user can operate, prepare inputs for, and interpret outputs of a system or component.
13. **Volume Test:** Done to see how the system responds to increasing data over a period of time
14. **Vulnerability Test:** Done with regards with regards to system security with the purpose to prevent problems which may affect the application integrity and stability.

Of all these 14, the five most important testing are: Black box, Unit, Module, Acceptance and Security testing

Question: Can you suggest best security measures for the proposed system?

Answer: Security has become an issue in recent times and there is a need to secure any system been deployed once it is a web based system. The network the system would be implemented needs to be secured as well as the system itself needs to be security oriented in order to preserve the safety of the information and data it would house. Security is a very sensitive issues and no one jokes with security especially when it has to do with organizational data like that of Institutions and colleges. I would suggest a couple of security measures just to be sure the system is safe enough:

- **Firewalls:**

I strongly recommended a firewall to prevent the network on which the system would be located. The network has a server and other workstations as well. This prevents unauthorized external access which is very necessary.

- **Access Control (Login with integrated sms notification):**

There is a need to segregate data into levels based on their importance. This is now accessible by the user based on the access right that has been assigned to the user which has to be authenticated from a mobile device. This is a way just to be sure the actual user is accessing the right information

- **Intrusion Prevention Capabilities:**

I personally suggest intrusion prevention capabilities that would help prevent impersonation of personality. In recent times, impersonation or using fake identity has now become rampant and it is not a good thing for the industry.

- **Intrusion Detection Capabilities:**

Intrusion detection capabilities would also prevent unauthorized access in a manner of trial and error to prevent the data of the users as well as the system information

- **Biometrics**

This involves the use of eye lens, facial recognition, finger prints or even palm just to be sure un-authorised access is not granted

A combination of all is not too much for an MIS of this nature. I would say it is not compulsory but necessary.

Question: In conclusion, what do you think the outcome of the proposed system would be like?

Answer: I have no doubt that the outcome of this system would be wonderful if developed well to meet its optimum features. I would like to see the system when it's finished because I have very high expectation

The analysis from the interview shows that

1. Features such as Login, Registration, Data manipulated, Managerial functionalities and Reports or charts should be basic to a system such as the Doctor's Scheduling system
2. User requirements is best generated from developers point of view and the steps include Identifying the active users, Identifying passive users, Identifying data that

each user would work with, Converting each active users data usage to requirement, Converting passive users data usage into requirements and Converting user requirement into system features

3. There is no suitable methodology for any system but consideration has to be given to the system and user requirements
4. There is no suitable programming language for any system but consideration has to be given to The system requirements, The user requirements, Language libraries and API's as well as Language support
5. There is no suitable database for a particular system, consideration has to be given to strengths and limitation of each database as well as front end integration and connectivity
6. There is no suitable from work but considerations is given to a couple of steps to develop one based of developer's preference. Consideration such as Problem Identification, Feasibility study, Research, Data gathering and analysis, Logical design, Physical design, Implementation and Testing, Integration and Documentation
7. Possible threats to look out for include: unclear goal definition, undeclared functions, unclear methodology, budget, dedicated staff, changing time and system coding and testing
8. Of all the test available, 5 are the most important at the preliminary stage which are: Unit, Module, Black box, Acceptance and Security
9. Security measures to consider include, firewall integration, access control, intrusion prevention, intrusion detection and possibly biometrics

4.4 PROJECT REQUIREMENTS

4.4.1 Major Requirement

The major requirements of the system is centred on doctors as an integral part of a hospital. This is not to say that there are no other requirements, but emphasis is laid on doctor. These requirements include:

- Scheduling doctors into shifts by admin or personnel in charge
- Booking appointment with doctors by patients
- Appointment approval and decline from doctors
- Doctors information update by doctors

Other requirements include

- Basic System Setup
 - Country settings
 - Currency settings
 - Time zone settings
 - Hospital creation
 - Module license management
- Hospital Settings
 - Employee information update
 - Hospital information update
- User Management
 - User account monitor and management
- Access Management
 - User management
 - Role management
 - Role setup
- Super Admin
- System Setup
 - System configuration and management
 - Theme configuration and management
 - Email configuration and management
- Monitor and Support
 - Audit log management
 - System log management
 - System monitor
 - Queue management
 - Ticket management
 - User feedback management

4.4.2 System Enhancement Requirements

System enhancement requirements describes the platform created in order for the system to be able to undergo enhancement in future without any technical issues. The

language and IDE used enables the current system to undergo enhancement in future as established by the tool itself. Enhancements in future might include

- Mobile app development
- Automating payment
- Scheduling other employees on shifts

4.4.3 *System Compatibility Requirement*

This is described in terms of operating system compatibility to accommodate the developed system to be able to run on different machines with different versions of the operating system. It has been developed on windows 8 but it can also run on windows 8.1 and 10

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